FINAL

ADDITIONAL DNAPL RECOVERY WELL INSTALLATION AND TESTING WORK PLAN

DETREX RD/RA SOURCE CONTROL AREA
DETREX FACILITY
ASHTABULA, OH
DOCKET NO. V-W-98-C-450

Prepared for
Detrex Corporation
Ashtabula, OH

August 24, 2012

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August 24, 2012

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Subject: Submittal of Final Additional DNAPL Recovery Well Installation and Testing Work Plan
Detrex Source Control Area – Fields Brook Superfund Site
Detrex Corporation, Ashtabula, Ohio
Docket No. V-W-98-C-450

Dear Mr. Thompson:

On behalf of Detrex Corporation (Detrex), URS Corporation (URS) has prepared the above-referenced Final Work Plan in response to the February 29, 2012 letter from the United States Environmental Protection Agency (USEPA) and SulTRAC based on their review of the Additional DNAPL Recovery Well Installation and Testing Work Plan that was submitted on February 6, 2012. In addition, Detrex received additional comments to the Work Plan dated July 25, 2012. This Final Work Plan is being submitted via email with hard copies to follow via US Mail.

If you have any questions regarding this submittal, please do not hesitate to contact me at 216-622-2432 at your convenience.

Sincerely,

URS Corporation - Ohio

Martin L. Schmidt, Ph.D.
Vice President

Enclosure

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This Work Plan has been prepared in response to a January 6, 2012 letter from the United States Environmental Protection Agency (USEPA), and subsequent correspondence and discussions concerning the investigation, design, installation, testing and operation of additional dense non-aqueous phase liquid (DNAPL) recovery wells at the Detrex Corporation (Detrex) Facility (Site) located in Ashtabula, Ohio. This letter also cited the October 28, 2011 USEPA letter regarding the Additional DNAPL Recovery Well/Slurry Wall Design and Work Plan, as well as the Draft ESD that was prepared by USEPA for comment closing December 12, 2011. As part of the review, Fields Brook Action Group (FBAG) provided comments in December 2011 to the Draft Explanation of Significant Differences (ESD) indicating that alternative recovery well design and DNAPL recovery methods could potentially enhance DNAPL recovery. Based on the response from USEPA, Detrex understands that the Draft ESD has been temporarily deferred pending the results of additional investigation and DNAPL recoverability testing at the Detrex Site. Following receipt of the January 6, 2012 USEPA letter and subsequent conference calls, Detrex indicated to USEPA that it would be preparing a Work Plan to address USEPA's comments.

Detrex submitted the Additional DNAPL Recovery Well Installation and Testing Work Plan (Work Plan) to USEPA on February 6, 2012. USEPA provided technical comments to the Work Plan on February 29, 2012 and gave approval to proceed with the Membrane Interface Probe (MIP) portion of the Work Plan. Responses to these comments along with copies of pertinent Agency correspondence are provided in Appendix A. Also, FBAG provided comments to the February 6, 2012 Work Plan in March 2012.

The MIP work was completed in March and May 2012 and reports describing the results of the investigation were previously submitted to USEPA on April 30, 2012 and May 24, 2012. Follow-up meetings were held in July 2012 with USEPA, Detrex and FBAG to discuss the MIP results and DNAPL recovery well design issues. On July 25, 2012, USEPA submitted a letter to Detrex indicating that pilot testing should proceed as outlined in the January 6, 2012 letter and that Detrex should finalize the February 2012 Work Plan in accordance with MIP investigation results and previous comments from both USEPA and FBAG.

This Work Plan has been updated to include technical comments received from USEPA and FBAG and describes the procedures for installation of additional DNAPL extraction wells and the associated testing activities. The Scope of Work (SOW), for the Work Plan described herein, consists of the following activities:

- **Existing On-site Well Inventory** - Review, inspection and data gathering of all on-site monitoring/recovery/piezometer wells;
- **Initial DNAPL Recovery Testing** – Completion of preliminary DNAPL recovery tests from existing wells (i.e., DNAPL recovery and monitoring wells);
- **DNAPL Recovery Well Design** – Completion of three alternative DNAPL recovery well designs and installation of six new recovery wells;

- **DNAPL Recovery Testing** – Completion of DNAPL recovery testing on the six new DNAPL recovery well designs; and
- **Surveying** – Completion of survey control for new investigative elements.

Detrex will also update the existing site-specific Health & Safety Plan (HASP) to reflect the fieldwork outlined as part of the proposed Scope of Work. Finally, Detrex will document the results of the DNAPL recovery testing in a Technical Memorandum as appropriate for submission to the USEPA.

The following sections outline the details and the methodology of these tasks.

1.1 HISTORY & BACKGROUND

Detrex Corporation (Detrex) operates a facility at 1100 North State Road in Ashtabula, Ohio. **Figure 1-1** depicts the general location of the Detrex Facility. On February 26, 1998, the United States Environmental Protection Agency (USEPA) issued a Unilateral Administrative Order (UAO) and a Scope of Work for Remedial Design and Remedial Action for the Detrex Source Area (the UAO SOW) requiring that Detrex develop plans and specifications for remedial measures at the facility.

Phase I Remedial Investigation/Feasibility Study (RI/FS) Source Control environmental assessment investigations identified an area in the northeast corner of the Detrex Facility where soil and groundwater have been impacted by chlorinated volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). Soil borings and monitoring wells in this area have also identified impacted soil that contains these VOCs and SVOCs, along with thin, discontinuous subsurface sand lenses and voids that contain DNAPL. The area was formerly occupied by a series of settling ponds that were taken out service and backfilled with soil. The former ponds were associated with manufacturing operations that have been discontinued at this facility.

Technical Memorandum 3 (W-C, May 1997) included a Feasibility Study that identified several conceptual remedial alternatives for the Detrex site. The USEPA selected Alternative No. IV in the Source Control Record of Decision (ROD) issued September 1, 1997, to address the environmental conditions identified at the facility and prevent recontamination of sediment within Fields Brook. Alternative IV included:

- A downgradient vertical barrier wall (slurry wall);
- A groundwater collection trench upgradient of the slurry wall;
- A groundwater collection trench beneath the DS Tributary;
- Removal of sediments from the northern drainage ditch;
- Re-grading activities in the northeastern portion of the property;
- Removal of the catalyst pile materials; and
- DNAPL Recovery System Installation.

Each of the action items, with the exception of the DNAPL recovery system, was addressed in the Plans and Specifications for Remedial Design/Remedial Action dated February 17, 2000. A Remedial Action Work Plan for those activities was issued on August 28, 2000 and work was initiated in September 2000. The slurry wall, collection trenches sediment excavation, site grading and catalyst pile removal were completed in March 2001.

The Plans and Specifications for DNAPL recovery system were issued at the 100 percent level on April 13, 2001. As agreed with USEPA, 12 of the 40 proposed recovery wells were installed in order to evaluate the DNAPL recovery system design as a pilot study prior to full-scale implementation. Construction of the pilot DNAPL recovery system was completed in

October 2002. Since October 2002, several modifications to the DNAPL recovery system, which have been completed and documented in quarterly reports, submitted to USEPA. In addition, two new recovery wells were installed in 2007 to evaluate alternative well designs and extraction pumps.

Based on the MIP and supplemental soil boring data collected in 2012, Detrex is proposing to install six (6) recovery wells to evaluate the performance of alternative recovery well designs. The proposed DNAPL recovery wells will focus on the northern portion of the site (i.e. former Lagoon Area). Based on discussions with USEPA, Detrex understands that the Draft ESD document has been temporarily deferred by the USEPA until the work outlined herein has been completed and evaluated. Further details are presented in the remainder of the Work Plan, documented herein. Detrex provided a proposed schedule of activities to USEPA in August 2011. A revised /updated schedule is provided in Section 4.1.

1.2 OBJECTIVES

The objective of this DNAPL Recovery Well Installation and Testing Work Plan is to evaluate three (3) alternative well designs that may potentially provide for enhanced collection and recovery of DNAPL in and surrounding the Former Lagoon Area of the Site (i.e. backfilled former Lagoon Area and surrounding impacted undisturbed soils).

1.3 WORK PLAN OUTLINE

The Work Plan, documented herein, is broken down into the following sections:

- **Section 1.0** – Introduction
- **Section 2.0** – DNAPL Recovery Investigation Scope of Work / Procedures
- **Section 3.0** – Health & Safety Program
- **Section 4.0** – Schedule
- **Section 5.0** –References

This section provides a summary of the existing DNAPL recovery system at the Site, an overview of the proposed SOW, and details related to the testing procedures planned for utilization during the recovery well testing program. The following sections provide additional details.

2.1 OVERVIEW OF EXISTING DNAPL RECOVERY SYSTEMS

This section provides a summary of the existing DNAPL recovery systems and operational issues at the Detrex Site.

2.1.1 Overview of Existing DNAPL Recovery Systems

The existing (pilot) DNAPL recovery system consists of a performance-scale, vacuum-enhanced DNAPL recovery system installed to remove readily recoverable DNAPL from the subsurface. Twelve (12) recovery wells (RW-1 through RW-12) were originally installed as a part of the DNAPL recovery pilot study. **Figure 2-1** depicts the location of the existing monitoring wells and DNAPL recovery wells. Additional enhancement to the DNAPL recovery system was completed in 2007 with the installation of two (2) DNAPL recovery wells (RW-13 and RW-14). To-date, the DNAPL recovery system has recovered an estimated 18,000 gallons of DNAPL and groundwater (i.e., emulsified product) from the subsurface since operations began in 2002. Since the original system was designed as a pilot system, it has been the intention of Detrex to enhance and optimize the operation of the system based on observed conditions at the Site. Concurrently, Detrex has also installed a number of other remedial measures at the Site (i.e., eastern slurry wall, eastern groundwater collection trench, and southern groundwater interceptor trench) to mitigate the potential impacts of DNAPL from the former Lagoon Area.

The original DNAPL recovery system was designed to operate continuously, although not all components of the system may have operated at a given time, based on site conditions. Key design considerations included the density of the DNAPL (specific gravity-1.5), the low permeability of the subsurface materials, and the incompatibility of the DNAPL constituents with certain common construction materials, such as poly vinyl chloride (PVC).

Previously completed work activities associated with the DNAPL recovery system include the following:

- **DNAPL Recovery Well Drilling and Installation** - Completion of 12, stainless steel, Phase I DNAPL recovery well installations along the northern border of Detrex property and running north-south from the northern boundary of Detrex property (see **Figure 2-1**).
- **DNAPL System Monitoring Wells** - Completion of three (3), stainless steel, Phase I DNAPL monitoring wells in the vicinity of the recovery wells for monitoring of groundwater levels and DNAPL thickness. Following the initial monitoring well installations, four (4) supplementary new monitoring wells were installed proximal to the DNAPL recovery wells to monitor DNAPL recovery.

- **Equipment Building Installation** - Installation of the equipment building, including but not limited to the foundation and floor slab, all specified plumbing, pumping stations, valves and manifolds, blowers, filters, DNAPL/water separator, DNAPL holding tank, and granular activated carbon treatment vessels.
- **Satellite Pump House Installation** - Installation of two (2) satellite pump houses, including but not limited to, all specified plumbing, pumps, valves, and manifolds.
- **Plumbing and Hardware Connections** - Installation of piping, braces and supports to connect the system together as described in previously submitted documentation, addenda, or written and approved changes or modifications.
- **Power Supply** - Installation of a power supply adequate to operate and maintain all components of the system.
- **Logic Controllers** – Installation of programmable logic controllers for the operation of the DNAPL recovery system components.
- **Additional DNAPL Recovery Wells** – Completion of two (2) stainless steel recovery wells installed using sonic drilling techniques with a larger borehole size and modified screen slot sizes. In addition, different DNAPL recovery pumps were installed.

2.1.2 Overview of Operation and Maintenance Issues

Since installation of the pilot DNAPL recovery system in October 2002, the system has recovered 18,000 gallons of DNAPL and groundwater. It should be noted that the reported recovery volumes consisted of an emulsified product. However, not all system components have historically functioned as anticipated, resulting in a high level of maintenance. Between October 2002 and September 2003, four wells were capped and taken off-line due to short-circuiting of injected air (RW-2 and RW-11) or excessive sediment production (RW-4 and RW-10). Silting within the original DNAPL recovery wells has been problematic since the startup of the system.

During Fall 2003 and Winter 2004, Detrex made several improvements to the treatment system, including the following:

- Installation of an approximately 500-gallon vertical stainless steel settling tank with a rounded base to receive the system influent in the treatment building. The existing DNAPL/water separator was removed;
- Replacement of the existing pump houses with 8'x 8' x 8' wood-framed buildings with heating, insulation, lighting and ventilation. The existing recovery pumps and vacuum boxes were re-used, and the manifolds were rebuilt and equipped with pneumatically actuated solenoid valves;
- Replacement of existing HDPE piping (tubing) with stainless steel piping due to sagging between supports and concerns that low spots may freeze. Detrex also replaced the HDPE drop tubes with stainless steel drop tubes;

- Redevelopment and sediment removal from all existing DNAPL recovery wells; and
- Installation of sleeves in two existing wells to assess the effectiveness of reducing available screen length in reducing short-circuiting.

Although the screens and casing of all recovery wells remain intact, select wells remain off-line due to short-circuiting or excessive silt production or DNAPL crystallization, despite the system improvements. Additionally, the anticipation is that the wells will likely require increased pressure over time to pump DNAPL, which will further exacerbate problems with short-circuiting. Based on a review of operational data as well as the ongoing maintenance issues with silt production, Detrex installed two (2) additional DNAPL recovery wells in 2007 to attempt to address the previously observed problems associated with DNAPL recovery at the Site. The utilization of rotosonic drilling techniques was employed to minimize smearing of the boreholes. The following changes to the existing well design and recovery system were as follows:

- To reduce or eliminate excess silt build-up including DNAPL crystals in the well, borehole diameter was increased to approximately 12-inches, and the screen size was decreased from 0.020 to 0.010 inches. In addition, a reduction in the grain size of the well sand pack allows less than 5% of the sand pack to pass through the screen.
- To avoid short-circuiting, the pumping system design was modified to eliminate the introduction of air into the recovery well screen.

The alternative recovery well design was implemented with the install of DNAPL recovery wells RW-13 and RW-14 in September 2007. Following installation, the DNAPL recovery wells were placed into operation. However, the re-designed DNAPL recovery wells continued to exhibit silting, as well as operations and maintenance issues, and low DNAPL recovery rates persisted. As a result, Detrex has again re-evaluated the DNAPL recovery system and is proposing further enhancements to the system designed to address noted operational issues.

2.2 PROPOSED SCOPE OF WORK

This Work Plan describes procedures that will be used to evaluate alternate recovery well designs within the former Lagoon Area. Based on comments received from USEPA in July 2012, two tasks previously described in the February 2012 Work Plan have been removed from the Work Plan (i.e., Former Lagoon Test Trenches and MIP Investigation). The methodologies planned for the implementation of the proposed SOW consist of the following activities:

- **Task 1** – Existing On-site Well Inventory
- **Task 2** – Initial DNAPL Recovery Testing
- **Task 3** – DNAPL Characterization
- **Task 4** - Preliminary DNAPL Recovery Well Design/Installation
- **Task 5** - DNAPL Recoverability Testing
- **Task 6** - Survey Control

- **Task 7 –** Technical Memorandum Preparation

The following sections outline the details and the methodology of these tasks.

2.3 PROPOSED INVESTIGATIVE PROCEDURES

Based on the tasks outlined above the following sections provide details related to the proposed investigative procedures contained in this Work Plan.

2.3.1 Existing On-site Well Inventory

Detrex will complete a site reconnaissance and data collection effort to gather information on existing recovery, monitoring, and piezometer wells located on the Detrex site in the vicinity of the former Lagoon Area. This information will subsequently be reviewed to prepare an inventory of all existing wells located on the Detrex property. Further, the completion of a site reconnaissance will also determine well/piezometer conditions, as well as to determine the presence of DNAPL occurring and the usefulness of wells for future monitoring.

As part of this task, the following data will be collected at each of the identified well locations:

- Horizontal and vertical coordinates and datum;
- Well and pad condition;
- Well size and material of construction;
- Well construction details (i.e., screen length, riser length, sand pack thickness, etc...);
- Depth to water and static water level elevation;
- Presence of DNAPL and/or DNAPL thickness and elevation; and
- Any other pertinent information.

The results of the well inventory will be summarized and presented in a spreadsheet to document the results of the fieldwork.

2.3.2 Initial DNAPL Recovery Testing

Existing monitoring wells, recovery wells and piezometers determined useable and located on the Detrex property (as described in previous section) will be tabulated (see Section 2.3.1), and a select number of these wells and piezometers will also be used to provide an initial / baseline evaluation of DNAPL recovery rates. At this time, it is anticipated that up to six wells in the former Lagoon Area and up to four wells outside the former Lagoon Area will be used for evaluation. The wells and piezometers will be gauged for the water elevations and the presence of any accumulated DNAPL.

The following information will be recorded in the field logbook at each location:

- Date and time;

- Barometric conditions, temperature, and general weather conditions;
- Depth to water measured from the surveyed top of the well casing;
- Depth to the top of DNAPL (if any); and
- Depth to bottom of well measured from the surveyed top of the well casing.

A standard electronic water level indicator and/or interface probe or tape will be used to take the measurements for locations located outside of the DNAPL impacted area. Additionally, the wells will be measured in order from least impacted to most impacted. This determination will be made based on the most current groundwater analytical results. The water level indicator will be decontaminated between each well.

DNAPL measurements will be collected utilizing a dedicated interface probe and/or tape, which is capable of measuring the top of the water column, as well as, the top of the DNAPL layer (if present). All monitoring well locations that routinely contain DNAPL will be either gauged using an interface probe and/or tape and or a bailer to manually assess the presence of DNAPL. If bailers are used they will be dedicated to each well. The interface probe will be properly decontaminated after each use. Visual observations for DNAPL or sheen will be recorded in the field logbook.

Based on the above measurements and well diameter, the volume of water and DNAPL standing in each well will be calculated. In wells containing DNAPL, purging will be attempted using a peristaltic pump, or similar appropriate equipment, by lowering dedicated tubing into the well. Placement of the tubing inlet in the well will be determined by the following measurements:

- Position tubing inlet to remove water column only above DNAPL (use calculated volume) then;
- Monitor time/rate of DNAPL increases in volume (elapsed time – 30 minutes) then;
- Position tubing inlet to remove DNAPL;
- Monitor time/rate of DNAPL inflow (return)(elapsed time – XX minutes)

All measurements will be recorded in the field logbook. All purge water and collected DNAPL will be containerized and processed through the Detrex water treatment system.

2.3.3 DNAPL Characterization (Physical / Chemical)

In order to further characterize the nature of the DNAPL within and proximal to the former Lagoon Area, samples of DNAPL and groundwater will be collected and submitted to Torkelson Geochemistry, Inc. for physical characterization. At this time, it is anticipated that approximately nine samples will be collected. Three samples will be collected from the center of the former Lagoon Area, three from the perimeter and three from the downgradient wells within the plant area. The physical characteristics to be determined are the following:

- Density of free product;
- Viscosity;
- Surface tension of water;
- Surface tension of DNAPL; and
- Interfacial tension of water and DNAPL.

As requested by USEPA in July 2012, chemical characterization of DNAPL will also be performed. The samples of DNAPL from the approximate nine (9) well locations will be collected and analyzed for Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs).

2.3.4 Preliminary DNAPL Recovery Well Design / Installation

As outlined in the USEPA letters dated January 6, 2012 and July 25, 2012, a minimum of six (6) extraction wells are to be installed and tested to provide for the evaluation of potential enhanced DNAPL recovery. These wells will include design parameters described and requested by USEPA and will be installed within and proximal to the central portion of the former Lagoon Area.

Results from the MIP and soil boring installation work completed in March – May 2012, indicate that DNAPL, when encountered, is generally observed as a sheen and ganglia within the water saturated soil matrix. The DNAPL material is typically identified in thin, discontinuous silt clay lenses and or voids. In addition, as described in reports submitted to USEPA, the location of the former Lagoon Area boundaries was mapped from historical aerial photography. Based on MIP results and soil boring descriptions there are two typical occurrences of subsurface materials. The first occurrence is a condition that exists in the backfilled portions of the former Lagoon Area where disturbed soil is encountered to approximately 10-15 feet below ground surface (ft-bgs). In these areas, DNAPL sheen and ganglia are observed beneath the backfill material in wet silty-sandy lenses at depths of 20 to 24 ft-bgs. The second occurrence is a condition that is identified in undisturbed areas of the site surrounding the former Lagoon Area. In these locations, DNAPL sheen and ganglia are observed at the geologic contact between the overlying lacustrine soils and underlying glacial till. Typically, this interface has a perched groundwater condition and exhibits a change in soil hydraulic conductivity of 10^{-4} to 10^{-5} cm/sec as compared to 10^{-7} to 10^{-8} cm/sec in the glacial till. **Figure 2-2** show locations of MIP and soil borings completed in 2012.

Because of these subsurface conditions and observations, it is apparent that there is no thick, continuous layer of DNAPL material observed anywhere on site. Rather the occurrence of DNAPL material is discontinuous, variable in depth depending on location with the facility and typically found in either backfill voids or wet silty clay / sand lenses that are typically less than 2 feet thick.

In order to evaluate recovery of DNAPL from these two different subsurface settings/occurrences, Detrex is proposing to install one well of each of the following three design types in each of the settings.

The DNAPL extraction well designs requested by USEPA in correspondence dated January 6, 2012 consist of the following types of DNAPL recovery wells:

- DNAPL recovery wells that would be intermittently operated using a Mobile DNAPL Recovery Unit (MDRU) that was outlined in the previous Work Plan (URS, 2011). At this time, Detrex has not built the MDRU. Existing equipment and pumps specified in this Work Plan will be used to test this type of well;
- DNAPL recovery wells operated using 2-Phase vacuum-enhanced in a similar operational mode to the existing DNAPL recovery wells;
- DNAPL recovery wells operated using a Dual-Phase vacuum-enhanced recovery methodology as proposed by FBAG; and
- DNAPL recovery wells utilizing other potentially applicable approaches based on the completed data evaluation.

The intent of the three proposed DNAPL recovery well designs is to evaluate well performance to determine if DNAPL recovery/removal can potentially be further optimized. The proposed new well designs will attempt to minimize the amount of silt and crystallized DNAPL entering the wells by increasing the volume of the filter pack and reducing the size of the well screen slots. The existing DNAPL recovery wells are typically constructed with 0.020-inch slotted screens installed in 4.25-inch boreholes drilled using hollow stem augers

The new DNAPL recovery wells will be installed in 12-inch diameter boreholes. The boreholes will be advanced using rotosonic (i.e., sonic) drilling techniques. Rotosonic drilling uses a combination of rotary motion and oscillation. During this process, the drill bit is vibrated up and down while also being pushed down and rotated. This creates a high frequency force that in overburden causes the soil particles to fluidize. Spoils are moved using water or compressed air. The primary advantage of the rotosonic technique is reduction of smearing of the borehole sidewalls as the borehole is completed and the reduction in the volume of spoils created.

In consideration of recent investigation results, the depth of each recovery well and position of the screened interval will be based on the location of sheen / DNAPL / and DNAPL ganglia in the subsurface. Existing MIP and soil boring data have been reviewed and proposed locations have been identified. The locations of the proposed DNAPL recovery well areas are shown on **Figure 2-2**. However, prior to installation of each recovery well, a pilot boring will be drilled using a Geoprobe rig to confirm occurrence and depth of DNAPL material prior to completion of the recovery well. Boring logs will be prepared for each location and will include the following information:

- A description of geologic materials and the depth at which encountered;
- Static water level;
- Boring termination depth;
- A description of problems and corrective measures; and
- The depth and diameter of the temporary casing.

Well casing materials will be 4.0-inch diameter, type 304 flush-threaded stainless steel or HDPE pipe. Well screens will be 4.0-inch diameter slotted stainless steel or HDPE pipe with 0.010-inch slots. Screen length will vary from depending on the thickness of the zone where DNAPL material is identified. The actual screen length will be determined based on field conditions and adjusted so the screened intervals in all wells are in contact with DNAPL occurrence. The filter pack will consist of poorly graded fine (USCS) sand with less than 5 percent passing a #8 standard sieve opening. The filter pack will extend 2 feet above the top of the screen. Proposed well construction details for each setting are presented in **Figures 2-3 and 2-4**.

2.3.4.1 Decontamination

All drilling equipment including any rotosonic equipment that comes in contact with subsurface materials will be decontaminated with a high-pressure hot water cleaning unit. All decontamination water will be collected and the liquid will be disposed of through the Detrex DNAPL recovery and treatment system.

2.3.4.2 Well Development

Following installation of the new DNAPL recovery wells, the wells will be developed by the drilling contractor and Detrex personnel by removing up to 10 well volumes of total fluids. During well development activities, the produced liquid will be visually inspected for turbidity and product. All purge water will be disposed of through the Detrex DNAPL recovery and treatment system.

2.3.4.3 Investigative-Derived Waste Handling

Investigative-Derived Waste (IDW) generated as part of the recovery well installations will be combined and managed on-site within the former Lagoon Area as part of the DNAPL Soils Management Plan. As described in the USEPA letter dated March 28, 2011, the agency has determined that generated soils from activities related to Source Control remediation efforts may remain on-site within the impacted area (i.e., former Lagoon Area). USEPA provided several provisions to Detrex if impacted soils are generated during field activities. These provisions included the following:

- There needs to be an affirmative determination that the material is remediation waste.
- The waste material must be kept within the area of contamination.

- The waste material must be controlled so as to pose no risk of migration.

Upon receipt of the March 28, 2011 letter, Detrex notified USEPA that it intends to utilize a DNAPL Soils Management Area within the historical footprint of the former Lagoon Area.

In order to comply with the requirements specified by the USEPA for on-Site Soil Management, Detrex will prepare an area within the footprint of the former Lagoon Area subsequent use as a Soils Management Area (SMA). Details related to the SMA were outlined in the previous Work Plan, (URS, 2011). It is further noted, that the area proposed for soils management has been previously backfilled with soil following the closure of the former lagoons in the mid-1970s. The former Lagoon Area is currently mounded and sloped radially. An approximate 75 ft x 75 ft area will be designated as the DNAPL Soils Management Area. All generated soils will then be placed within the limits of the berm. Materials placed within the berm will be minimally compacted and graded.

Upon completion of the field installation activities and placement of the generated soils, the DNAPL SMA will be covered as outlined in the previous Work Plan (URS, 2011).

2.3.5 DNAPL Recoverability Testing

Upon completion of well development, the six newly installed DNAPL recovery wells will be subjected to DNAPL recoverability testing. The testing will be completed in phases as outlined below:

- Initial DNAPL Recovery Testing;
- Enhanced DNAPL Recoverability Testing; and
- Data Evaluation / Reporting.

Details related to each of the DNAPL recoverability testing phases are presented in the subsequent sections.

2.3.5.1 Initial DNAPL Recovery Testing

Following the installation and development of the six (6) DNAPL recovery wells, initial DNAPL recovery testing will be completed to establish baseline DNAPL recovery rates / conditions. The testing procedures for the initial DNAPL recovery testing will be the same as those outlined in Section 2.3.2. Also, it is anticipated that the vacuum source and pumps described in Section 2.3.5.2 may be applied to the six (6) recovery well initially for short periods of time (approx. 24 hours) to evaluate DNAPL and groundwater flow conditions prior to testing.

2.3.5.2 Enhanced DNAPL Recoverability Testing

As outlined in the USEPA letter dated January 6, 2012, the enhanced DNAPL recoverability testing is designed to generate data needed to evaluate system performance and optimize

system configuration. Three designs of potential DNAPL recovery wells will be evaluated as part of the testing program, including:

- Discontinuously operated DNAPL Recovery Wells (proposed in URS Work Plan,2011);
- Two-Phase vacuum enhanced DNAPL Recovery Wells (similar to existing system); and
- Dual-Phase vacuum enhanced DNAPL Recovery Wells (i.e., FBAG design).

Two new recovery wells of each of the above designs will be tested. However, independent of the number or location, the proposed testing program will be consistent for each of the new DNAPL recovery wells. A schematic layout for the DNAPL recovery well testing program is presented in **Figures 2-5 and 2-6**. Locations of all new recovery wells and radial monitoring wells will be verified using field observations.

During the enhanced DNAPL recoverability testing program, several procedures will be used to facilitate recovery of fluids and further evaluate the proposed well designs. The following general operational aspects will be used during testing program.

- Discontinuously operated DNAPL Recovery Wells

  This well design is intended to evaluate the proposed recovery well operation originally proposed by Detrex in 2011. The well screen will be located in contact with soil zones containing DNAPL. A vacuum source (~25-inches Hg) will be applied to the wellhead for approximately 8 hours, and then terminated. The following day, a total fluids pump will be used to recover all liquids from the well. Measurements will be made to record DNAPL, water levels and volumes extracted. Approximately one week later these same procedures will be followed again. The testing period may continue for up to two months.

- Two Phase vacuum-enhanced DNAPL Recover Wells

  This well design is intended to evaluate the recovery well operation that is currently being used by Detrex. The well screen will be located in zones containing DNAPL. A vacuum source (~25 inches Hg) will be applied to the wellhead on a continuous basis. A total fluids pump will be used to recover all liquids from the well on a continuous basis. Measurements will be made to record DNAPL, water levels and volumes extracted on a continuous basis. The testing procedure may be continued for up to two months on each well.

- Dual-Phase vacuum-enhanced DNAPL Recovery Wells

  This well design is intended to evaluate the recovery well operation that has been proposed by FBAG. The well screen will be located in contact with zones containing DNAPL. A vacuum source (~25 inches Hg) will be applied to the wellhead on a continuous basis. Two separate pumps will be used to recover groundwater and DNAPL from the well on a continuous basis. Measurements will be made to record DNAPL, water levels and volumes extracted on a continuous basis. The testing procedures may be continued for up to two months on each well.

As illustrated in **Figure 2-6**, each of the new well locations will have a minimum of four (4) radial monitoring locations in order to provide for data collection. This orientation will provide for the spatial evaluation of capture zones, radius of influence, and the possible heterogeneities for DNAPL movement. It is anticipated that due to the low permeability of the subsurface materials that up to two (2) months of testing may be required for each well. However, the actual testing period will be subject to variability based on the ongoing collection of field data. If steady state conditions are observed, then testing times may be shortened in order to facilitate the timely completion of the fieldwork.

As outlined in the January 6, 2012 USEPA letter along with technical comments provided by USEPA and FBAG, the data collection will include, but not be limited to, the following types of data during the completion of each of the DNAPL recoverability tests.

- Depth to water and depth DNAPL in recovery wells.
- Depth to water and depth to DNAPL in any monitoring well within the monitoring well array.
- Measurement of vacuum pressures throughout recovery system from wellhead to the vacuum pump and from radial monitoring well network on a continuous basis.
- Flow rate and total volume of water and DNAPL as separate phases extracted from recovery wells.
- Flow rate of vapor and concentration of organic constituents in vapor phase extracted from recovery wells.

In order to facilitate the proposed DNAPL recoverability testing, Detrex is proposing to utilize dual-phase extraction system trailers that will be mobilized to the Site for the duration of the testing period. At this time, Detrex is proposing to contract with TDM and ProAct Services Corporation in order to rent a Dual Phase Extraction System unit that will be utilized to complete the testing. TDM/ProAct will mobilize and deliver 140 CFM/5gpm Dual Phase Extraction trailer (Unit 45 Series) to the Site and provide personnel to set-up and shakedown the unit prior to the start of testing. The Unit 45 Series trailer is equipped with a 10Hp oil-sealed liquid ring vacuum pump that capable of applying a high vacuum (>25-inches Hg) on a continuous basis. The Unit 45 Series trailer is also equipped with water pumps, flow meters, PLC, pressure/vacuum gauges, sample ports, etc... Additional details and specifications related to the Unit 45 Series trailer is provided in **Appendix B** of this Work Plan. In addition, Detrex plans to use separate variable speed direct drive pumps manufactured and sold by Pump Works, Inc. in order to facilitate the removal of groundwater and DNAPL from each recovery well. The groundwater and DNAPL pumps that are being specified for use in the DNAPL recovery testing are the Pump Works PW2000 Series. These pumps are capable of pumping either water or DNAPL at variable flow rates using a variable-rate pump control box. URS has successfully used these pumps at other sites where DNAPL recovery wells have been installed.

Additional details and specifications for the Pump Work pumps are also provided in **Appendix B.**

2.3.6 Surveying

All MIP locations and boring locations have been surveyed and recorded on drawings.

Upon completion of well installation and development, the six (6) new DNAPL recovery wells and radial monitoring wells will also surveyed prior to the initiation of DNAPL Recoverability Testing.

2.3.7 Data Evaluation / Reporting

Following the completion of the DNAPL Recoverability Testing, the data will be evaluated and a Technical Memorandum will be prepared summarizing the testing procedures, results, interpretation, conclusions, and recommendations. It is anticipated that this documentation will be submitted to USEPA 30 days after the fieldwork has been completed. Additionally, a Technical Meeting with USEPA, URS, and Detrex is being proposed to review the results and conclusions of the DNAPL testing program.

A site specific Health and Safety Plan (HASP) has been previously prepared for drilling and sampling activities at the Detrex Site. An Addendum to the existing HASP will be prepared, as necessary and used for the completion of the installation of the supplemental DNAPL recovery wells, construction of the DNAPL Soils Management Area, and DNAPL recovery testing. During the completion of the fieldwork, it is anticipated that upgrades to Level B may be required. Prior to initiating the fieldwork, specific safety procedures for using Level B equipment will be reviewed by all personnel. In addition, engineered controls using fans to ventilate work areas will be considered.

Detrex will provide a copy of the revised HASP to the USEPA prior to the initiation of the field activities outlined in this Scope of Work.

This section provides details related to the proposed schedule for completing the items outline in Section 2.0. Detrex is prepared to initiate the SOW, documented herein, upon USEPA approval to proceed. All outlined field activities will commence as soon as possible (weather permitting) of notice to proceed depending on subcontractor availability. It should be noted that if the recovery well testing period extends into winter months and temperatures are below freezing, the testing procedures might need to be temporarily suspended. Discharge lines and water containment vessels will not be winterized and water may freeze if temperatures are below freezing. A generalized schedule was previously submitted to USEPA separately, and an updated schedule is provided below.

4.1 PROPOSED UPDATED SCHEDULE

The following provides a general overall project schedule:

- **Work Plan Submittal** – August 24 2012
- **Work Plan Approval / USEPA Notice to Proceed** – mid-September 2012
- **Well Inventory** – September 2012
- **Initial DNAPL Recovery Testing** – October 2012
- **DNAPL Recovery Well Design and Installation** – October through November 2012
- **DNAPL Recoverability Testing** – November 2012 through February 2013
- **Project Completion Report** – March 2013
- **Recovery Well Performance Technical Meeting** – March 2013

The following annotated reference lists provides a review of references that have been cited by FBAG as case studies where multi-phase extraction (MPE) has been used to successfully remediate DNAPL impacted sites. This section also contains references for this Work Plan. Based on URS' review of these references, there are no site case histories provided that indicate DNAPL has been successfully removed from contaminated project sites using MPE technologies.

NNEMS, 2012. "Dense Nonaqueous Phase Liquid Cleanup: Accomplishments at Twelve NPL Sites." Report to U.S. EPA, Office of Solid Waste and Emergency Response. August 2012.

This reference provides an overview of conventional and innovative remediation technologies to address DNAPL, dissolved, vapor or sorbed phase contamination. DNAPL remediation technologies commonly employed are described and include containment, removal and treatment. The case studies summarized include the following treatment technologies: in-situ bioremediation, in-situ chemical oxidation, electrical resistance heating, pump and treat/air sparge; MPE/SVE; and monitored natural attenuation/slurry wall. Also, most case studies have VOCs issues in groundwater aquifers and have RODs that use MCLs as remedial goals. There are no case studies presented that reference DNAPL removal/extraction via extraction wells as a remedial technology.

URS Corporation. *Additional DNAPL Recovery Well / Slurry Wall Design and Work Plan,* prepared for Detrex Corporation, September 2011.

URS Corporation. *Additional DNAPL Recovery Well / Slurry Wall Design and Work Plan,* prepared for Detrex Corporation, February 2012.

USEPA, 1997b. "Presumptive Remedy: Supplemental bulletin: Multi-phase extraction (MPE) Technology for VOCs in Soil and Groundwater." EPA 540-F-97-004; OSWER Directive No. 9355.0-68FS. April.

This reference provides information on MPE technology for extraction of VOCs present in soil and groundwater. The fact sheet recommends MPE as a potential valuable enhancement for Soil Vapor Extraction (SVE) options under the presumptive remedy for sites with VOCs in soils. Upon review of the case studies provided in Appendix A, there is no mention of DNAPL removal. The results presented are focused on vadose zone and groundwater mass removal issues and do not reference DNAPL removal.

USEPA, 1999. "Multi-Phase Extraction: State of the Practice." EPA 542-R-99-004. June.

The reference provides an overview of the "State of the Art Practice" for MPE extraction. The MPE technology specifically involves soil vapor extraction and groundwater pump and treat on a sealed recovery well. The MPE technology is applied to recovery wells that have wells screens extending above the water table into the vadose zone. The reference sites three case studies where MPE technology has been used. Upon review of these case studies, there is no mention of effective DNAPL cleanup. The data presented discussed removal of VOC contamination from the vadose zone and shallow groundwater. One case study was operated as a one-year pilot test and all three studies were focused on mass removal from soil and not extraction of DNAPL.

USEPA, 2004. "How to Evaluate Cleanup Technologies for Underground Storage Tank Sites." EPA 510-R-04-002, Appendix XI. May.

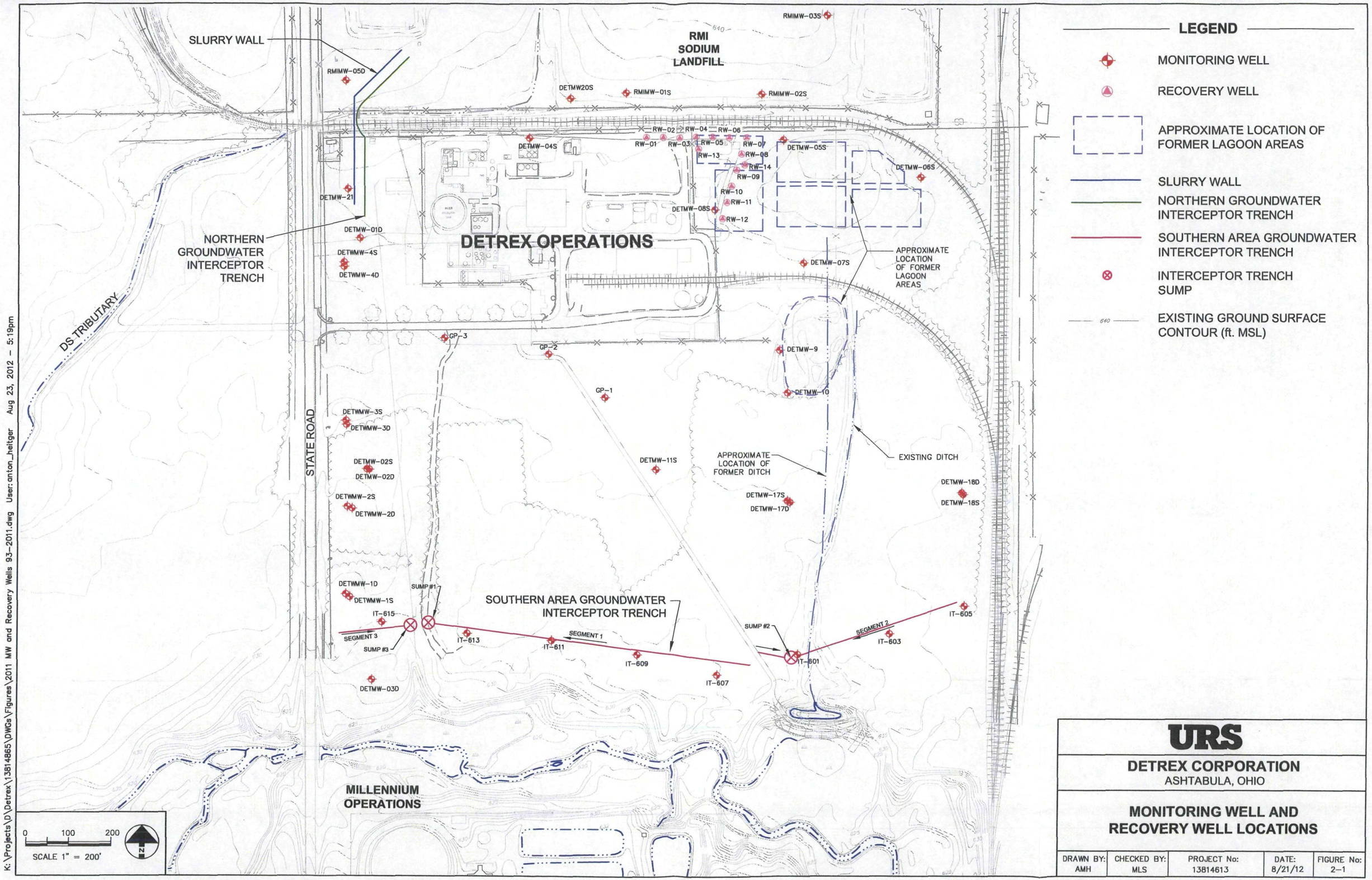
It should be noted that USEPA has guidance for evaluating alternative cleanup technologies that include screening criteria for evaluating DPE effectiveness. These criteria include: intrinsic permeability; soil structure and stratification, moisture content and depth to groundwater. Screening tools provided by USEPA indicate that DPE technologies are ineffective for clay and glacial till soils that have intrinsic permeabilities in the 10^{-12} to 10^{-14} cm^2 (see Exhibit XI-8). Results from investigation work at the Detrex site indicate that the soils are in this permeability range. Therefore, DPE technology may be ineffective for DNAPL removal.

USEPA, January 6, 2012 Letter, *Status of Explanation of Significant Differences (ESD) for Additional DNAPL Recovery Well/Slurry Wall Design and Work Plan,* United States Environmental Protection Agency – Region 5.

USEPA, February 29, 2012 Letter, *Additional DNAPL Recovery Well Installation and Testing Work Plan*, URS Corporation, February 2012.

USEPA, July 25, 2012 Letter, *Additional DNAPL Recovery Well Installation and Testing Work Plan*, URS Corporation, February 2012.

FIGURES



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URS

DETREX CORPORATION
ASHTABULA, OHIO

MONITORING WELL AND RECOVERY WELL LOCATIONS

DRAWN BY:	CHECKED BY:	PROJECT No:	DATE:	FIGURE No:
AMH	MLS	13814613	8/21/12	2-1

SLURRY WALL

RMI SODIUM LANDFILL

BACKFILL AREA (DEEP)

NORTHERN GROUNDWATER INTERCEPTOR TRENCH

DETREX OPERATIONS

MIP-1 MIP-47 MIP-2 MIP-3 MIP-4 / GP-4 MIP-5 MIP-48 GP-48 GP-8 MIP-6 MIP-7 MIP-11 GP-11 MIP-9 GP-7 MIP-8W MIP-8E MIP-10 / GP-10 MIP-12 MIP-13 MIP-14 MIP-15 GP-15 GP-16 MIP-16 GP-20 MIP-20 MIP-21 / GP-21 MIP-18 MIP-19 MIP-23 MIP-26 / GP-26 MIP-49/ GP-49 MIP-24 / GP-24 MIP-25 / GP-25 MIP-27 MIP-28 / GP-28 MIP-22 MIP-29 / GP-29 MIP-30 / GP-30 MIP-32 MIP-31 MIP-45 MIP-36 / GP-36 MIP-37 MIP-38 MIP-33 MIP-46 MIP-35 MIP-39 MIP-34 / GP-34 GPMW-10 MIP-43 MIP-44 MIP-42 MIP-41

APPROXIMATE LOCATION OF FORMER LAGOON AREAS

UNDISTURBED AREA (SHALLOW)

STATE ROAD

EXISTING DITCH

APPROXIMATE LOCATION OF FORMER DITCH

SUMP #1 SUMP #2 SUMP #3

SOUTHERN AREA GROUNDWATER INTERCEPTOR TRENCH

SEGMENT 3 SEGMENT 1 SEGMENT 2

MILLENNIUM OPERATIONS

0 100 200

SCALE 1" = 200'

LEGEND

- MIP LOCATIONS
- CONFIRMATORY GP BORING LOCATIONS
- CONFIRMATORY GP LOCATIONS ADVANCED IN MAY 2012 WITH USEPA
- APPROXIMATE LOCATION OF FORMER LAGOON AREAS
- PROPOSED PILOT TEST AREAS
- EXISTING GROUND SURFACE CONTOUR (ft. MSL)
- SLURRY WALL
- NORTHERN GROUNDWATER INTERCEPTOR TRENCH
- SOUTHERN AREA GROUNDWATER INTERCEPTOR TRENCH
- INTERCEPTOR TRENCH SUMP

URS

DETREX CORPORATION
ASHTABULA, OHIO

MIP BORINGS AND CONFIRMATORY SOIL BORINGS LOCATION MAP

DRAWN BY:	CHECKED BY:	PROJECT No:	DATE:	FIGURE No:
AMH	MLS	13814865	8/21/12	2-2

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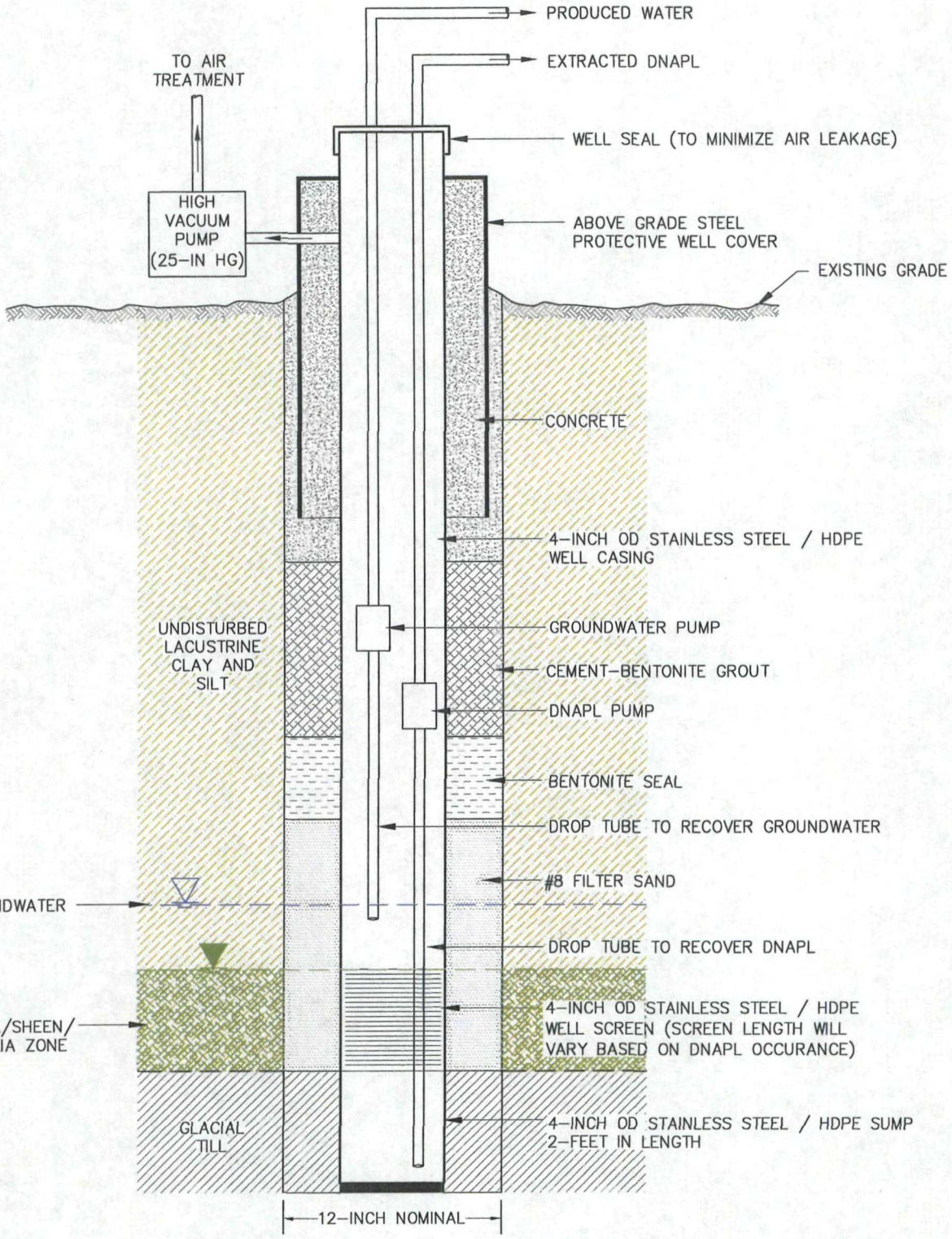

NOTES:

1. WELLS SHALL BE INSTALLED SUCH THAT THE SCREENED INTERVAL IS IN CONTACT WITH THE IDENTIFIED DNAPL ZONE.
2. A STEEL PROTECTIVE COVER SHALL BE INSTALLED OVER EACH WELL TO PROTECT THE WELL FROM DAMAGE.
3. DRAWING NOT TO SCALE

URS

DETREX CORPORATION

ASHTABULA, OHIO

DNAPL AND GROUNDWATER RECOVERY WELL SCHEMATIC IN NATURAL / UNDISTURBED SOIL

DRAWN BY:	CHECKED BY:	PROJECT No:	DATE:	FIGURE No:
AMH	MLS	13814865	8/20/12	2-3

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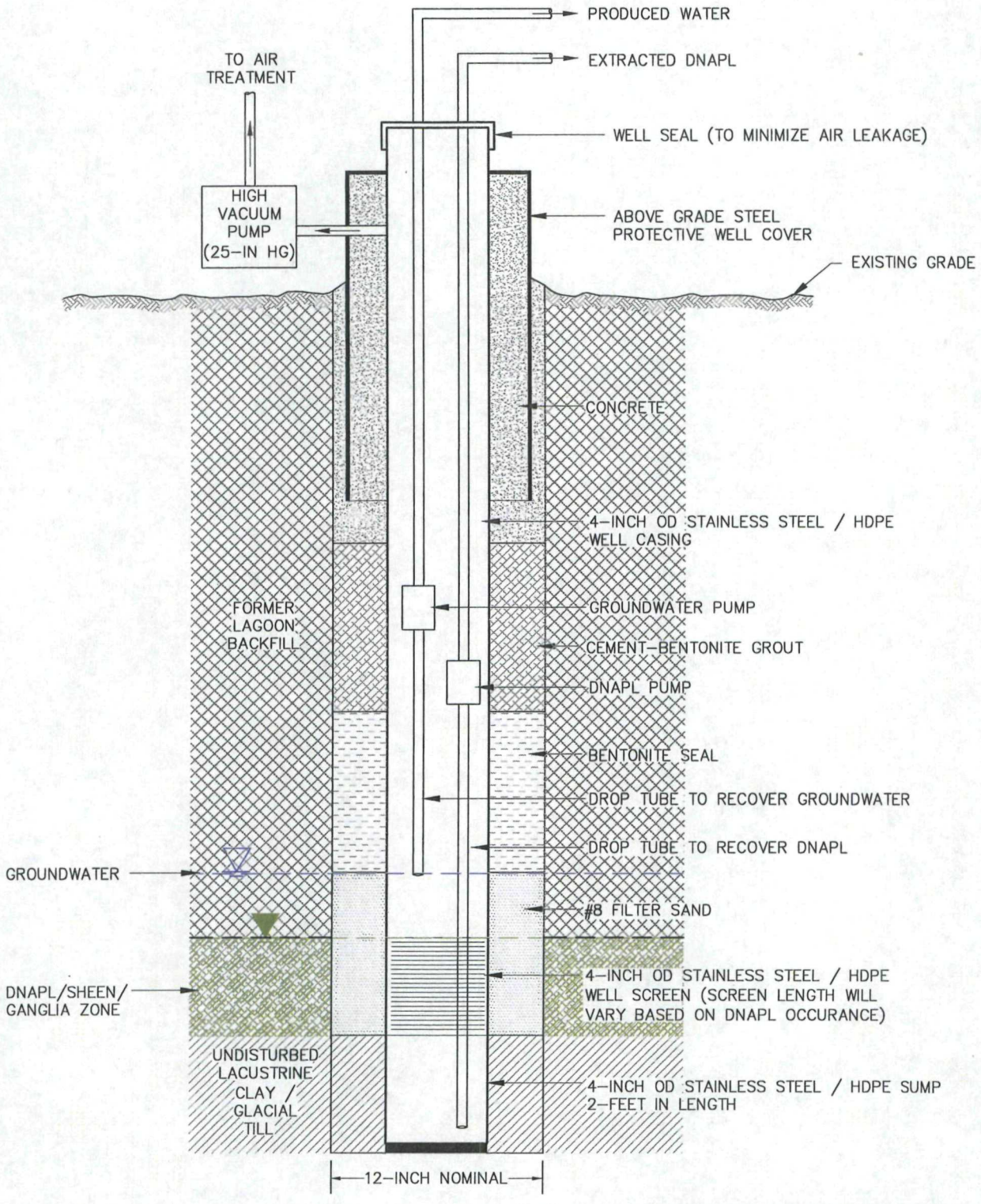

NOTES:

1. WELLS SHALL BE INSTALLED SUCH THAT THE SCREENED INTERVAL IS IN CONTACT WITH THE IDENTIFIED DNAPL ZONE.
2. A STEEL PROTECTIVE COVER SHALL BE INSTALLED OVER EACH WELL TO PROTECT THE WELL FROM DAMAGE.
3. DRAWING NOT TO SCALE

URS

DETREX CORPORATION

ASHTABULA, OHIO

DNAPL AND GROUNDWATER RECOVERY WELL SCHEMATIC IN FORMER LAGOON BACKFILL

DRAWN BY:	CHECKED BY:	PROJECT No:	DATE:	FIGURE No:
AMH	MLS	13814865	8/20/12	2-4

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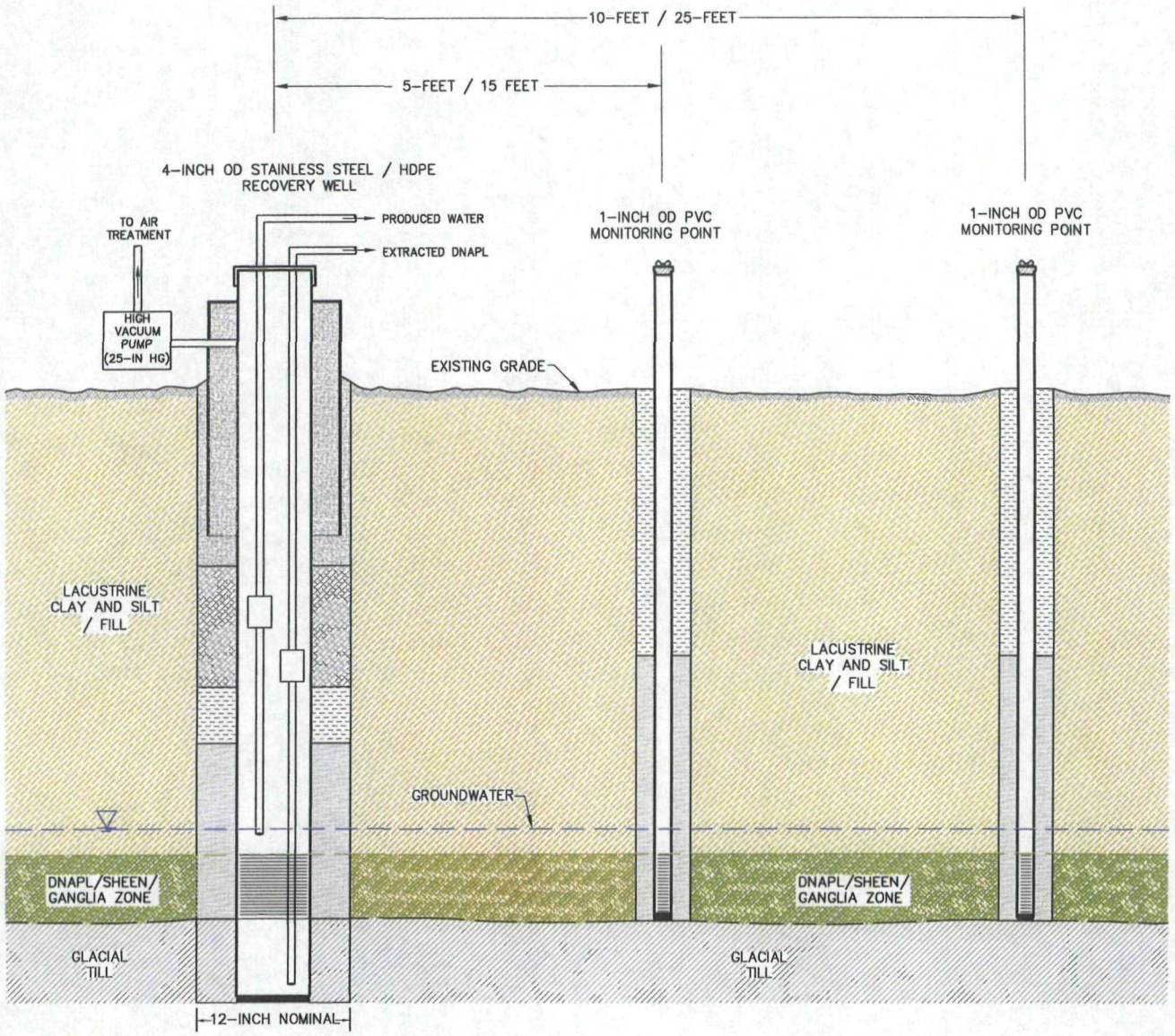

NOTES:

1. WELLS SHALL BE INSTALLED SUCH THAT THE SCREENED INTERVAL IS IN CONTACT WITH THE IDENTIFIED DNAPL ZONE.
2. A STEEL PROTECTIVE COVER SHALL BE INSTALLED OVER EACH WELL TO PROTECT THE WELL FROM DAMAGE.
3. DRAWING NOT TO SCALE

URS

DETREX CORPORATION

ASHTABULA, OHIO

DNAPL AND GROUNDWATER RECOVERY WELL MONITORING ARRAY SCHEMATIC

DRAWN BY:	CHECKED BY:	PROJECT No:	DATE:	FIGURE No:
AMH	MLS	13814865	8/21/12	2-5

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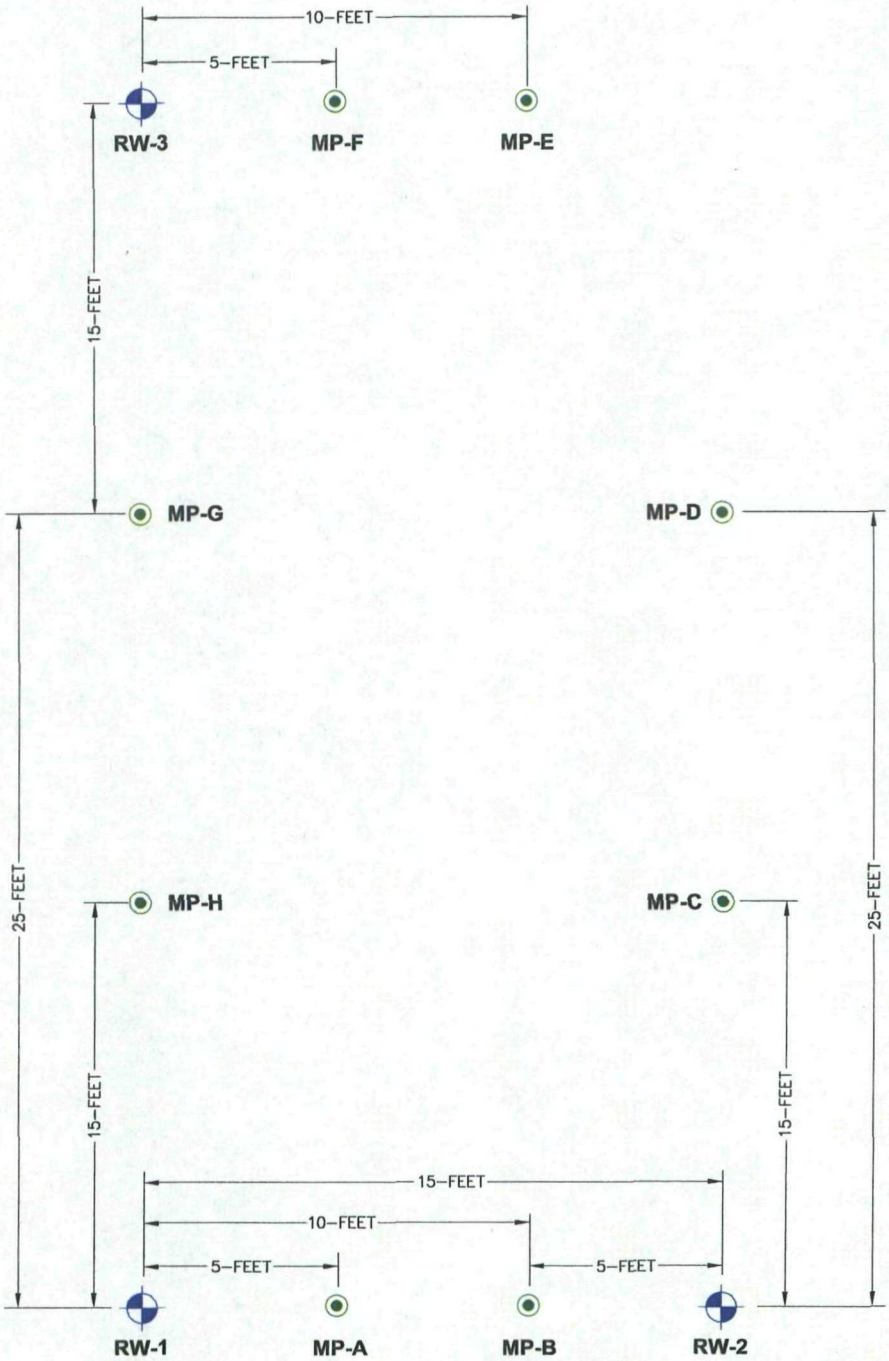

NOTES:

1. 3 RECOVERY WELLS AND 8 OBSERVATION WELLS PER ZONE (SHALLOW OR DEEP)
2. DRAWING NOT TO SCALE

URS

DETREX CORPORATION

ASHTABULA, OHIO

DNAPL AND GROUNDWATER RECOVERY WELL AND MONITORING POINT ARRAY LAYOUT

DRAWN BY:	CHECKED BY:	PROJECT No:	DATE:	FIGURE No:
AMH	MLS	13814865	8/16/12	2-6

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APPENDICES

APPENDIX A
AGENCY CORRESPONDENCE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, ILLINOIS 60604

REPLY TO THE ATTENTION OF: SR-6J

January 6, 2012

Thomas W. Steib
Operations Manager
Detrex Chemicals Division
Elco Corporation
1100 N. State Road
Ashtabula, OH 44004

Re: *Status of Explanation of Significant Differences (ESD) for Additional DNAPL Recovery Well/Slurry Wall Design and Work Plan* URS Corporation, September 2011

Dear Mr Steib:

Following up to my October 28, 2011 letter on the *Additional DNAPL Recovery Well/Slurry Wall Design and Work Plan*, EPA drafted an ESD and held the comment period open until December 12, 2011. After careful consideration of comments received, we have decided not to make a decision on an ESD until after the Membrane Interface Probe (MIP) investigation is completed and additional pilot tests are run on alternative extraction well designs.

Detrex has approval to proceed with the MIP portion of the *Work Plan* (Section 5.1). You may proceed with the MIP investigation immediately in order to take advantage of the unusually mild weather we are currently experiencing. The MIP investigation may be expanded in the former lagoon area to provide additional sample locations than those already identified in the *Work Plan.*

The Source Control ROD for Detrex requires DNAPL to be removed from the source area to the extent practicable. We need more information to determine which type of well design works best at your site.

Please prepare a work plan for an evaluation of DNAPL extraction wells, to be located in the central portion former lagoon area. At least six extraction wells should be installed, two each of the following types:

1. The discontinuously-operated type with MDRU, as proposed in the *Work Plan*
2. Two phase Vacuum-Enhanced, similar to the existing wells
3. Dual Phase Vacuum-Enhanced, as proposed by the FBAG
4. Additional extraction wells, of a different design than listed above, may also be installed

The investigation should generate the types of information that is needed to evaluate system performance and to optimize system configuration. Data should be collected and reported on a weekly basis until the extraction system response is fully understood and consistent data are being produced. New monitoring wells, piezometers, or probes should be located in close proximity to the extraction wells, and in sufficient geometry and number to allow a spatial representation of the capture zone and recognition of possible heterogeneities for DNAPL movement. Site response should be monitored closely, to ensure inward gradients are being achieved, DNAPL production rates are understood, and localized monitoring wells are confirming that DNAPL thickness in the source area monitoring wells is decreasing in a steady, gradual fashion. At a minimum, the following parameters should initially be measured and analyzed on the frequency sufficient to support efficacy of the technology or full scale design.

- Vacuum pressure in the DNAPL extraction wells – wells should be instrumented to collect these data continuously, beginning at system startup;
- Water and DNAPL level data – wells should be instrumented to collect these data continuously, beginning at system startup (in the DNAPL extraction wells and monitoring wells); and
- Flow rate and total volume of DNAPL recovered from extracted gasses, groundwater, and DNAPL.

We would expect these wells to operate for approximately six months before making any further decision on the ESD. Please submit a draft work plan and construction schedule to EPA within 30 days.

I can be reached by phone at 312 886-4843 if you have any questions.

Sincerely,

W. Owen Thompson

W. Owen Thompson
Remedial Project Manager
Superfund Division

Attachment

cc: Peter Felitti, U.S. EPA, C-14J
Regan Williams, Ohio EPA NEDO
Robert Currie, Detrex
Martin Schmidt, URS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, ILLINOIS 60604

REPLY TO THE ATTENTION OF: SR-6J

February 29, 2012

Thomas W. Steib
Vice President Manufacturing
Detrex Chemicals Division
Elco Corporation
1100 N. State Road
Ashtabula, OH 44004

Re: *Additional DNAPL Recovery Well Installation and Testing Work Plan*
URS Corporation, February 2011

Dear Mr Steib:

EPA has completed its review of the subject work plan, transmitted on Detrex' behalf by Martin Schmidt of URS on February 6, 2012.

Our technical comments are attached. Please address the comments by preparing a revised or Draft Final version of the Work Plan, which should then be provided concurrently to EPA and the Fields Brook Action Group for review.

You have EPA approval to proceed with the MIP portion of the investigation on March 5 as scheduled. We would like to schedule a teleconference as soon as possible to discuss health and safety considerations so that we can plan appropriate oversight next week.

I can be reached by phone at 312 886-4843 if you have any questions.

Sincerely,

W. Owen Thompson
Remedial Project Manager
Superfund Division

Attachment

cc: Peter Felitti, U.S. EPA, C-14J
Regan Williams, Ohio EPA NEDO
Robert Currie, Detrex
Tom Doll, Detrex
Martin Schmidt, URS
William Earle, SulTRAC

U.S. Environmental Protection Agency Region 5

TECHNICAL REVIEW COMMENTS ON
"ADDITIONAL DNAPL RECOVERY WELL INSTALLATION
AND TESTING WORK PLAN"
URS Corporation, February 2012

DETREX RD/RA SOURCE CONTROL AREA - FIELDS BROOK SUPERFUND SITE
ASHTABULA, OHIO

Comments Prepared February 29, 2012

SPECIFIC COMMENTS

1. Section 1.1, Page 1-2: The text states "As agreed with USEPA, 12 of the 36 proposed recovery wells were installed to evaluate..." 40 recovery wells were proposed in the ROD, please revise.

2. Section 1.1, Page 1-3: The text states, "Detrex also continues to believe that the ESD is the best technical approach to addressing the DNAPL issues at the Site." The draft Explanation of Significant Difference (ESD) document presents the best technical approach to confining dense nonaqueous-phase liquid (DNAPL) to the site; however, it is not the best technical approach for recovering and removing DNAPL from the subsurface. The text should be revised to clarify this difference.

3. Section 2.1.1, Page 2-1: The text states that Figure 2-1 depicts the location of the existing DNAPL recovery wells. Please revise Figure 2-1 or add another figure to depict the location of the existing wells. The text also states that the DNAPL recovery system has recovered an estimated 16,000 gallons of DNAPL. Revise this to 18,000 gallons.

4. Section 2.3.2, Page 2-4: The text proposes two test trenches installed in the former lagoon area to evaluate migration pathways and accumulation areas for DNAPL. The trenches are proposed to be 15 to 18 feet deep, 2 feet wide, and 50 to 100 feet long. The proposed narrow width and wide depth of the trenches will make safe inspection difficult. The text should be revised as needed to include a more detailed description of how the trenches will be inspected and safety measures put in place to protect workers.

5. Section 2.3.2, Page 2-4: The text states that the two test trenches will be 50-100 feet long. The text should be revised to explain how the final trench length will be determined.

6. Section 2.3.2, Page 2-5: The text states that test trench soils will be temporarily stockpiled on site and backfilled into the trenches upon completion of the trench observation. The text should be revised to include the location of the stockpile area and procedures for creating the temporary stockpile area, including procedures for preventing the spread of contamination and the monitoring and suppression of vapors from DNAPL impacted soils.

7. Section 2.3.3, Page 2-5: The "Additional DNAPL Recovery Well/Slurry Wall Design Work Plan" states that the membrane interface probe (MIP) will be driven at 1 foot per minute (URS 2011). The text in the current work plan should be revised to describe how the probe will be advanced. For example, it could be advanced continuously or set at different depths using the push-and-hold method. The push-and-hold method may be slower overall, but in heterogeneous subsurface materials (like those at the site), this method can provide better data. In addition, the text does not state if any quality control (QC) samples

will be collected during the MIP investigation. The text should be revised to describe how many and which type(s) of QC samples will be collected, including how many trip blank and field duplicate samples. Also, the text should be revised to state how the MIP gas and tubing will be checked and monitored during the investigation and how frequently the gas and the MIP will be serviced during the investigation. Finally, the text states that "upon completion of each location, the dataset is wirelessly delivered to remote servers location in Columbia's headquarters." The text should be revised to indicate how frequently the data will be reviewed by the field geologist during the field investigation.

8. Section 2.3.4, Page 2-6: The text states that an interface probe "will only be used in monitoring wells [to gauge DNAPL thickness] that routinely contain DNAPL" and all other locations will be assessed for the presence of DNAPL using a bailer. The same method should be used at all locations to ensure consistent results. The text should be revised to state locations that routinely contain DNAPL will be either gauged using both an interface probe and a bailer or in the same way for all locations. In addition, the text should be revised to state that the interface probe will be properly decontaminated between all locations.

9. Section 2.3.4, Page 2-7: The text states that initial DNAPL recovery testing will be performed by "[monitoring] time/rate of DNAPL increases in volume...[and monitoring] time/rate of DNAPL inflow (return)." The text should be revised to provide details on how the DNAPL volume change will be measured during initial DNAPL recovery testing.

10. Section 2.3.4.1, Page 2-7: The text states that physical characteristics of the DNAPL will be determined, including "surface tension of NAPL; and interfacial tension of water and DNAPL." The text should be revised to provide details on how surface and interfacial tension will be measured, using both qualitative and quantitative methods if possible.

11. Section 2.3.5, Page 2-8; and Figures 2-4 and 2-5: The text states that "new DNAPL recovery wells will be installed in 12-inch diameter boreholes"; however, Figures 2-4 and 2-5 show the boreholes as having a 10-inch-diameter. The text and figures should be revised as needed to resolve this discrepancy.

12. Section 2.3.5, Page 2-9: The text states that "currently contemplated/proposed well construction details are presented in Figures 2-3 through 2-4." Figure 2-3 shows the existing recovery well design, and Figure 2-4 shows the new proposed well design. The text should be revised to explain how each design will operate, the differences between the existing and proposed designs, and how the two designs will be evaluated and selected during the recovery well design and testing phases.

13. Section 2.3.5.3, Page 2-9: Revise "Investigative-derived water" to "Investigative-derived waste". The text discusses the plan for investigation-derived waste handling during the proposed work. The proposed plan is to "prepare an area within the footprint of the former lagoon area for subsequent use as a soil management area [SMA]." The SMA is located in an area where recovery wells may be installed in the future. The text should be revised to discuss anticipated impacts, if any, of installing recovery wells through the stockpiled waste material in the SMA.

14. Section 2.3.6.2, Page 2-11: The text states that "Presently, URS has to mobile units..." Revise to "two mobile units".

REFERENCE

URS Corporation (URS). 2011. "Additional DNAPL Recovery Well/Slurry Wall Design and Work Plan, Detrex RD/RA Source Control Area - Fields Brook Superfund Site, Detrex Corporation, Ashtabula, Ohio." September.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, ILLINOIS 60604

REPLY TO THE ATTENTION OF: SR-6J

July 25, 2012

Thomas W. Steib
Operations Manager
Detrex Chemicals Division
Elco Corporation
1100 N. State Road
Ashtabula, OH 44004

Re: *Additional DNAPL Recovery Well Installation and Testing Work Plan*
URS Corporation, February 2012

Dear Mr Steib:

On January 6, 2012, EPA directed Detrex to prepare a work plan for the installation and evaluation of DNAPL recovery wells. Detrex prepared the work plan and submitted a draft to EPA on February 6, 2012. EPA gave Detrex authorization to proceed with the MIP Investigation portion of the Work Plan (Task 2.3.3) on February 26. Implementation of the rest of the work was deferred until completion of the MIP investigation.

Detrex proceeded with the MIP investigation, and the results were presented in two reports:

1. *Results of Membrane Interface Probe and Soil Boring Investigations*, Detrex Source Control Area, URS Corp., April 30, 2012, and
2. *Results of Additional Soil Borings Investigation, Detrex Source Control Area*, URS Corp., May 24, 2012.

Follow-up meetings were held on July 10, 2012 with the Fields Brook Action Group (FBAG) and on July 12, 2012 with Detrex Corp. to discuss the results of the MIP and Soil Boring Investigations and DNAPL recovery well design issues.

After review of the data and consultation with FBAG and Detrex, EPA has determined that the pilot test should proceed as outlined in our January 6, 2012 letter and thus Detrex should finalize the February 2012 Work Plan, incorporating the comments provided below, the results of the MIP investigation, and EPA's February 26, 2012 technical comments.

In regard to the Proposed Additional Scope of Work presented in the February 2012 Draft Work Plan, EPA requires the following:

- Task 1 – Existing On-Site Well Inventory – This task should be completed concurrently with finalizing the Pilot Test Work Plan.
- Task 2 – Former Lagoon Test Trenches – Do not proceed with this task at this time.
- Task 3 – MIP Investigation – This task is complete.
- Task 4 – Initial DNAPL Recovery Testing – Information collected from existing wells is needed and should be integrated with the Well Pilot Test (Tasks 5 & 6). For DNAPL characterization, add chemical characterization for VOCs and SVOCs at each of the nine locations.
- Task 5 – Preliminary DNAPL Recovery Well Design – The proposed meetings were held in July. Proceed with finalizing the well designs for six pilot wells, utilizing the MIP results to determine optimal well placements and screen intervals.
- Tasks 6 – DNAPL Recoverability Testing – To begin after the final Pilot Test Work Plan is approved. Recovery testing on existing wells and DNAPL characterization testing can proceed at any time.
- Task 7 – Surveying – Proceed as appropriate.

Please submit a revised work plan and construction schedule to EPA within 21 days.

I can be reached by phone at 312 886-4843 if you have any questions.

Sincerely,

W. Owen Thompson
Remedial Project Manager
Superfund Division

cc: Peter Felitti, U.S. EPA, C-14J
Regan Williams, Ohio EPA NEDO
Robert Currie, Detrex
Martin Schmidt, URS

URS

August 24, 2012

Mr. W. Owen Thompson
Remedial Project Manager
Superfund Remedial Response Section Seven
U.S. EPA Region 5, SR-6J
77 W. Jackson Blvd.
Chicago, IL 60604
Phone (312) 886-4843
Machine Fax (312) 353-8426

Subject: Response to "Technical Review Comments on Additional DNAPL Recovery Well Installation and Testing Work Plan – URS Corporation February 2012
Detrex RD/RA Source Control Area - Fields Brook Superfund Site
Detrex Corporation, Ashtabula, Ohio
Docket No. V-W-98-C-450

Dear Mr. Thompson:

On behalf of Detrex Corporation (Detrex), and in response to a letter dated February 29, 2012 from the United States Environmental Protection Agency (USEPA) supplying comments from USEPA and SulTRAC Inc. based on their review of the above mentioned document, URS Corporation (URS) has prepared the following response letter. In addition, USEPA provided additional comments to the Work Plan on July 25, 2012. USEPA comments are provided in ***bold italic***, followed by the Detrex response.

SPECIFIC COMMENTS

Specific Comment #1 - Section 1.1, Page 1-2: The text states "As agreed with USEPA, 12 of the 36 proposed recovery wells were installed to evaluate... "40 recovery wells were proposed in the ROD, please revise.

Detrex Response:

Detrex agrees, and the text will be corrected and submitted in the Final Work Plan document.

Specific Comment #2 - Section 1.1, Page 1-3: The text states, "Detrex also continues to believe that the ESD is the best technical approach to addressing the DNAPL issues at the Site." The draft Explanation of Significant Difference (ESD) document presents the best technical approach to confining dense non-aqueous-phase liquid (DNAPL) to the site; however, it is not the best technical approach for recovering and removing DNAPL from the subsurface. The text should be revised to clarify this difference.

Detrex Response:

Detrex continues to believe that due site-specific conditions, the draft ESD does represent an alternative technical approach for the Site. The proposed remedy in the ESD was formerly evaluated as a potential remedy and was not selected based on available data at that time. Since the implementation of the selected remedy additional data has been collected that indicates that DNAPL recovery is problematic given the site-specific conditions, and further that DNAPL migration from the former lagoon area to the Fields Brook and the DS Tributary has not been substantiated. Detrex will review the text in question and make revisions as appropriate.

URS Corporation
1375 Euclid Avenue
Suite 600
Cleveland, OH 44115
Tel: 216.622.2400
Fax: 216.622.2464
www.urscorp.com

Specific Comment #3 - Section 2.1.1, Page 2-1: The text states that Figure 2-1 depicts the location of the existing DNAPL recovery wells. Please revise Figure 2-1 or add another figure to depict the location of the existing wells. The text also states that the DNAPL recovery system has recovered an estimated 16,000 gallons of DNAPL. Revise this to 18,000 gallons.

Detrex Response:

Detrex agrees, and the text will be corrected and submitted in the Final Work Plan document. Figure 2-1 has been revised to show the locations of existing monitoring wells and DNAPL recovery wells.

Specific Comment #4 - Section 2.3.2, Page 2-4: The text proposes two test trenches installed in the former lagoon area to evaluate migration pathways and accumulation areas for DNAPL. The trenches are proposed to be 15 to 18 feet deep, 2 feet wide, and 50 to 100 feet long. The proposed narrow width and wide depth of the trenches will make safe inspection difficult. The text should be revised as needed to include a more detailed description of how the trenches will be inspected and safety measures put in place to protect workers.

Detrex Response:

In the July 25, 2012 letter, USEPA requested that the scope of work for excavation of test trenches not be performed at this time. The following response has been prepared, if the work is performed at a later date.

The use of test trenches has been previously utilized as part of investigations at the Site by both Detrex and FBAG. The trenches are excavated using conventional construction equipment and they provide for the visual inspection of the subsurface. Detrex has no intention of sending personnel into the trenches as part of the field investigation. The test trenches will remain open for a minimum of 8 hours to allow for the visual observation of possible groundwater or DNAPL accumulation. All observations are intended to be made by personnel from the edge of the trench while standing on the ground surface. Backfilling of the open test trenches will only be completed after all parties agree that appropriate conditions have been observed.

The text will be deleted in the Final Work Plan document.

Specific Comment #5 - Section 2.3.2, Page 2-4: The text states that the two test trenches will be 50-100 feet long. The text should be revised to explain how the final trench length will be determined.

Detrex Response:

In the July 25, 2012 letter, USEPA requested that the scope of work for excavation of test trenches not be performed at this time. The following response has been prepared, if the work is performed at a later date.

The final trench length will be determined based upon the observed stability of each individual trench, and the trench will be extended to the appropriate length based on the interpretation of field personnel. If trench length is shortened, then additional trench location may be added to the field work, based on field observations. These decisions will be made in consultation with USEPA field oversight personnel.

The text will be deleted in the Final Work Plan document.

Specific Comment #6 - Section 2.3.2, Page 2-5: The text states that test trench soils will be temporarily stockpiled on site and backfilled into the trenches upon completion of the trench observation. The text should be revised to include the location of the stockpile area and procedures for creating the temporary stockpile area, including procedures for preventing the spread of contamination and the monitoring and suppression of vapors from DNAPL impacted soils.

Detrex Response:

In the July 25, 2012 letter, USEPA requested that excavation of test trenches not be performed at this time. The following response has been prepared if the work is performed at a later date.

The test trench soils will be stockpiled within the footprint of the former lagoon area. Excavated soils will be placed on top of an HDPE liner material to prevent direct contact with the ground surface. The soils will also be covered with HDPE and sand bags to minimize vapors and exposure to field personnel.

The text will be deleted in the Final Work Plan document.

Specific Comment #7 - Section 2.3.3, Page 2-5: The "Additional DNAPL Recovery Well/Slurry Wall Design Work Plan" states that the membrane interface probe (MIP) will be driven at 1 foot per minute (URS 2011). The text in the current work plan should be revised to describe how the probe will be advanced. For example, it could be advanced continuously or set at different depths using the push-and-hold method. The push-and-hold method may be slower overall, but in heterogeneous subsurface materials (like those at the site), this method can provide better data. In addition, the text does not state if any quality control (QC) samples will be collected during the MIP investigation. The text should be revised to describe how many and which type(s) of QC samples will be collected, including how many trip blank and field duplicate samples. Also, the text should be revised to state how the MIP gas and tubing will be checked and monitored during the investigation and how frequently the gas and the MIP will be serviced during the investigation. Finally, the text states that "upon completion of each location, the dataset is wirelessly delivered to a remote server location in Columbia's headquarters." The text should be revised to indicate how frequently the data will be reviewed by the field geologist during the field investigation.

Detrex Response:

USEPA gave Detrex approval to proceed with the MIP field work in the January 6, 2012 letter. The MIP was completed in March 2012 and the results of the investigation were submitted to USEPA in a report dated April 30, 2012.

The standard advancement rate for the MIP probe, as supplied by the vendor, is 1 foot / minute. This is the planned approach for completing the MIP investigation. Since the data is transmitted to the surface in real-time, adjustments can be made as the collected data is reviewed.

QC sampling is not typically performed when using the MIP probe because a separate borehole is required in order to generate each MIP log. However, Detrex plans on completing soil borings at selected MIP locations based on the near real-time evaluation of the MIP results. QA/QC samples will be collected for the soil and/or groundwater samples on a frequency of 1 per 20 samples, in agreement with the existing QAPP for the Site. Trip blanks will accompany any sample sets that are sent to the off-site laboratory for analysis.

The MIP probe is maintained by the subcontractor and is routinely monitored by subcontractor personnel. These O&M issues are documented by the subcontractor and any problems are reported to URS field personnel.

The MIP logs are transmitted to the remote server as appropriate. Prior experience indicates that the logs completed on any given day are typically available the same day they are completed, and often available nearly immediately after completion in the field. Since the MIP data is available essentially in real-time, field personnel will review the data following the completion of each MIP location.

The text will be deleted in the Final Work Plan document.

Specific Comment #8 - Section 2.3.4, Page 2-6: The text states that an interface probe "will only be used in monitoring wells [to gauge DNAPL thickness] that routinely contain DNAPL" and all other locations will be assessed for the presence of DNAPL using a bailer. The same method should be used at all locations to ensure consistent results. The text should be revised to state locations that routinely contain DNAPL will be either gauged using both an interface probe and a bailer or in the same way for all locations. In addition, the text should be revised to state that the interface probe will be properly decontaminated between all locations.

Detrex Response:

Detrex agrees, and the text will be revised and submitted in the Final Work Plan document.

Specific Comment #9 - Section 2.3.4, Page 2-7: The text states that initial DNAPL recovery testing will be performed by "[monitoring] time/rate of DNAPL increases in volume... [and monitoring] time/rate of DNAPL inflow (return)." The text should be revised to provide details on how the DNAPL volume change will be measured during initial DNAPL recovery testing.

Detrex Response:

Detrex does not believe that this section of the Work Plan requires any further revision. The text in Section 2.3.4 does outline the general procedures to be used in evaluating the presence and volume of potential DNAPL in any of the wells included in the DNAPL recovery testing. The data being collected consists of water and DNAPL level measurements, when combined with the well construction details can be readily converted into volumes. The procedures and data used in these determinations will be documented in the DNAPL Technical Memorandum.

Specific Comment #10 - Section 2.3.4.1, Page 2-7: The text states that physical characteristics of the DNAPL will be determined, including "surface tension of DNAPL; and interfacial tension of water and DNAPL." The text should be revised to provide details on how surface and interfacial tension will be measured, using both qualitative and quantitative methods if possible.

Detrex Response:

Detrex agrees, and the text will be revised and submitted in the Final Work Plan document.

Specific Comment #11 - Section 2.3.5, Page 2-8; and Figures 2-4 and 2-5: The text states that "new DNAPL recovery wells will be installed in 12-inch diameter boreholes"; however, Figures 2-4 and 2-5 show the boreholes as having a 10-inch-diameter. The text and figures should be revised as needed to resolve this discrepancy.

Detrex Response:

Detrex agrees. Figures 2-3, 2-4, and 2-5 have been revised to reference the use of 12 inch boreholes for DNAPL recovery wells.

Specific Comment #12 - Section 2.3.5, Page 2-9: The text states that "currently contemplated / proposed well construction details are presented in Figures 2-3 through 2-4." Figure 2-3 shows the existing recovery well design, and Figure 2-4 shows the new proposed well design. The text should be revised to explain how each design will operate, the differences between the existing and proposed designs, and how the two designs will be evaluated and selected during the recovery well design and testing phases.

Detrex Response:

Detrex agrees. The text in Section 2.0 has been revised to explain how each well design will be installed, operated and evaluated during the testing program. The text will be revised and submitted in the Final Work Plan document.

Specific Comment #13 - Section 2.3.5.3, Page 2-9: Revise "Investigative-derived water" to "Investigative-derived waste". The text discusses the plan for investigation-derived waste handling during the proposed work. The proposed plan is to "prepare an area within the footprint of the former lagoon area for subsequent use as a soil management area [SMA]." The SMA is located in an area where recovery wells may be installed in the future. The text should be revised to discuss anticipated impacts, if any, of installing recovery wells through the stockpiled waste material in the SMA.

Detrex Response:

Detrex agrees and the text will be revised to reference waste and not water.

Detrex does not believe that this section of the Work Plan requires any further revision. Since no significant quantities of IDW will be generated during the recovery well drilling program, the proposed small footprint for the SMA is unlikely to have any potential impacts related to the installation of potential future recovery wells.

The text will be revised and submitted in the Final Work Plan document.

Specific Comment #14 - Section 2.3.6.2, Page 2-11: The text states that "Presently, URS has to mobile units ... " Revise to "two mobile units".

Detrex Response:

It should be noted that a vendor supplying state of the art equipment will be used to provide high vacuum blowers and ancillary equipment for completing the DNAPL recovery tests. The text will be revised and submitted in the Final Work Plan document.

Detrex believes that the responses included herein, address the comments presented in the USEPA letters dated February 29, 2012 and July 25, 2012. Detrex also continues to assert that based on the existing data there is no apparent DNAPL migration pathway from the former source area to either Fields Brook or the DS Tributary. The completion of the numerous groundwater investigations, MIP investigation and soil boring investigations performed to date have provided the additional assurance that any potentially DNAPL migration pathways within the former source area have been identified and characterized. Detrex looks forward to agency approval of the Final Work Plan and the successful completion of the outlined field activities as soon as practicable.

If you have any questions regarding this submittal, please do not hesitate to contact me at 216-622-2432 at your convenience.

Sincerely,

URS Corporation - Ohio

Martin L. Schmidt, Ph.D.
Vice President

Enclosure

cc: R. Currie – Detrex Corporation
T. Steib – Detrex Corporation
T. Doll - Detrex Corporation
R. Williams – Ohio EPA
W. Earle – SulTRAC
File

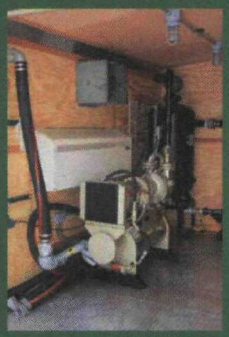
APPENDIX B
DUAL-PHASE TESTING TRAILER AND PUMP SPECIFICATIONS

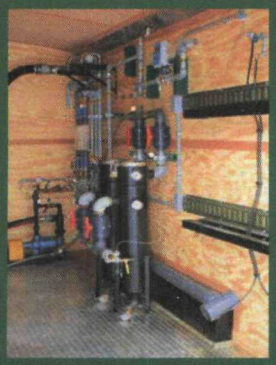
Dual Phase Extraction System

Liquid Ring pump/Bag filter/Carbon adsorbers

Unit# 45

Environmental Treatment Specialists





General Specifications:	5 GPM water pump 140 ACFM @28" Hg
Trailer:	8ft wide x16 ft long x 7 ft height 7,000 pound double axle trailer
Main Equipment:	10 Hp oil sealed Liquid Ring pump 80 gallon knock out tank w/clean out port 5 GPM XP ¾ Hp Moyno pump 2-200 lb carbon adsorbers 2 LCO8 Rosedale Bag Filters Erdco Flow Meter (air) Totalizing water flow meter Vacuum & Pressure gauges, sample ports
Trailer Specifications:	XP Lights, heater and fan in equipment room Components in equipment room wired for XP Outside light and control panel
Control Panel:	PLC (Program Logic Controller) HAO switch – all components Emergency stop button Fault lights and reset GFI
Inlet Hose Connection:	4- Male camlock 3- 1" & 1-2" inlet fittings (4 well manifold including site glass, flow meter, vacuum gauge flow control valve
Outlet Hose Connection:	3" air stack for LRP (18 Ft. high) Vapors can be plumbed for off-gas treatment 1" male camlock water discharge
Power Requirements:	230 Volt, 3 phase, 100 Amp services (Main fused disconnect located outside trailer) 230 Volt, 1 phase, 100 Amp service (w/phase converter)

ProAct Services Corporation

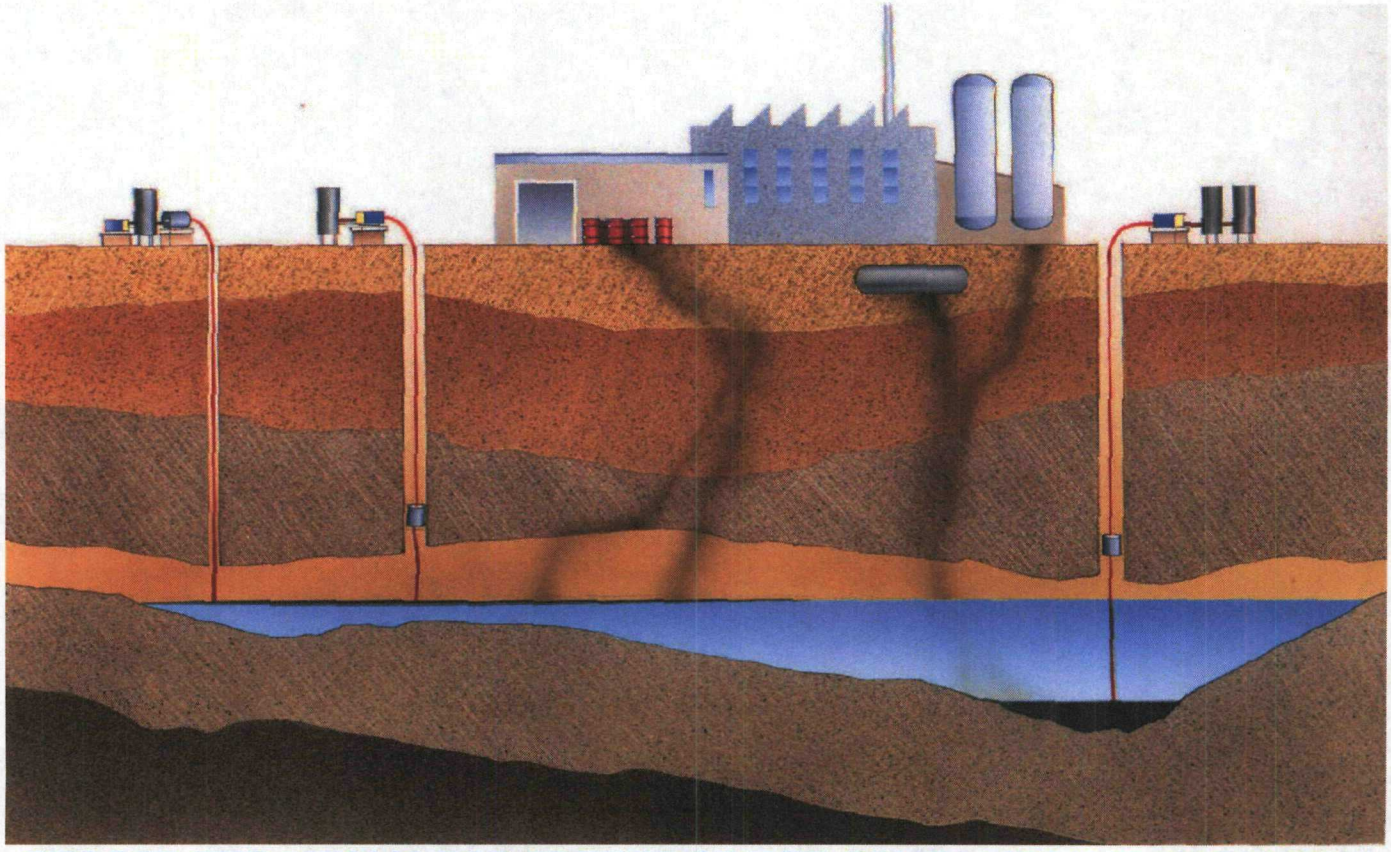
Corp Office: 231-843-2711
Gulf Coast: 210-862-6467
or 713-202-6351
Midwest Office: 231-342-1115
East Coast Office: 203-262-1200

www.proact-usa.com

Texas • Colorado • Michigan • New Jersey • Connecticut

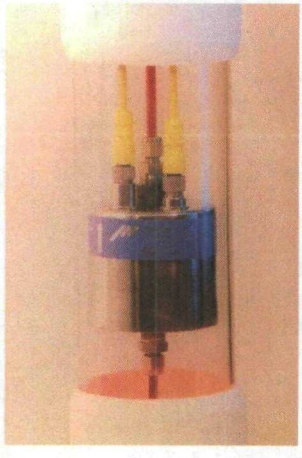
PUMPWORKS, INC.

LOW COST, LOW FLOW DNAPL & LNAPL RECOVERY



CHOOSE THE PW2002 FOR FREE PRODUCT CONTAMINANT RECOVERY

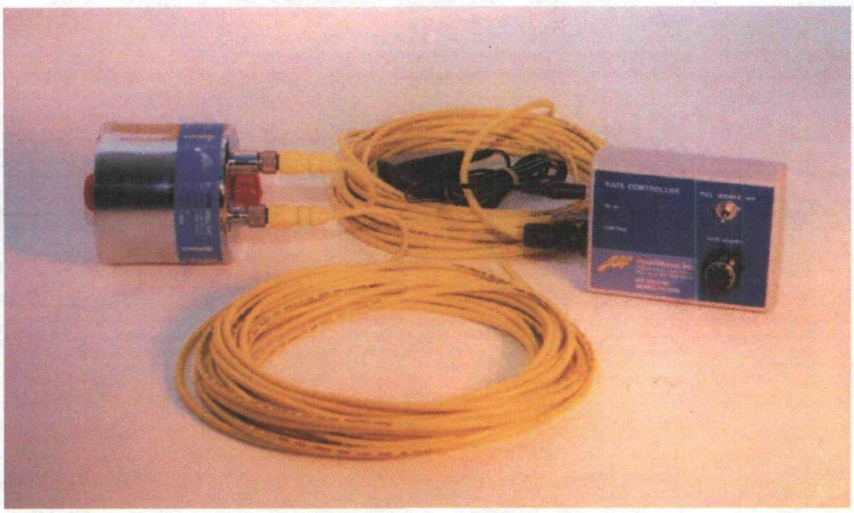
- CONTROLLABLE FOR LOW FLOWS AND LOW TURBIDITY
- FITS IN WELLS 4" AND LARGER
- SELF-PRIMING WITH 30' SUCTION LIFT
- VACUUM TO 25" Hg AND PRESSURES TO 40 PSI
- SIMPLE DESIGN AND COMPACT SIZE



COMPRESSED AIR

New Linear Dual Solenoid Reciprocating Piston Pumps are an efficient and versatile new option for free product recovery of both denser than water and lighter than water contaminants. The Model PW2002 pump, one of the durable PW2000 series of pumps, has a number of features that make it an ideal choice.

The pump has only one moving part and two check valves, enhancing both its durability and longevity. The pumps are guaranteed leak-proof, so contaminants only go where you want. The patented compact design, measuring only 3.5" in both length and diameter, fits easily into a 4" pipe and weighs less than 5 pounds. Power requirements are 115VAC for both pump and controller. The accompanying rate controller allows complete controllability for low recovery rates of less than 1 gal/day up to 5 gph depending on well depth, material viscosity and desired flow rate. Low flow rates yield low turbidity, preventing contaminants from reentering the groundwater. Cables come with connectors to the pump that are rated NEMA 6P for prolonged submersible applications and cable lengths up to 25 meters are available. Inlet and outlet are both 3/8" female NPT fittings. If desired, add a NEMA box and run 115VAC/GFI to the box to power both pump and controller.



OPTIONS

For shallow well recovery of less than 25 feet, the pump may be used from the surface with well diameters small enough to accommodate only the recovery tubing.

For recovery from depths greater than 25 feet, a 4" well or larger is necessary for inserting the pump and lowering it to the desired depth.

Recommended possible additions (not currently offered by PumpWorks, Inc.)
100 micron strainer on inlet
Collection container with dry contact float switch (connection option is on rate controller)
NEMA enclosure for rate controller if left on site

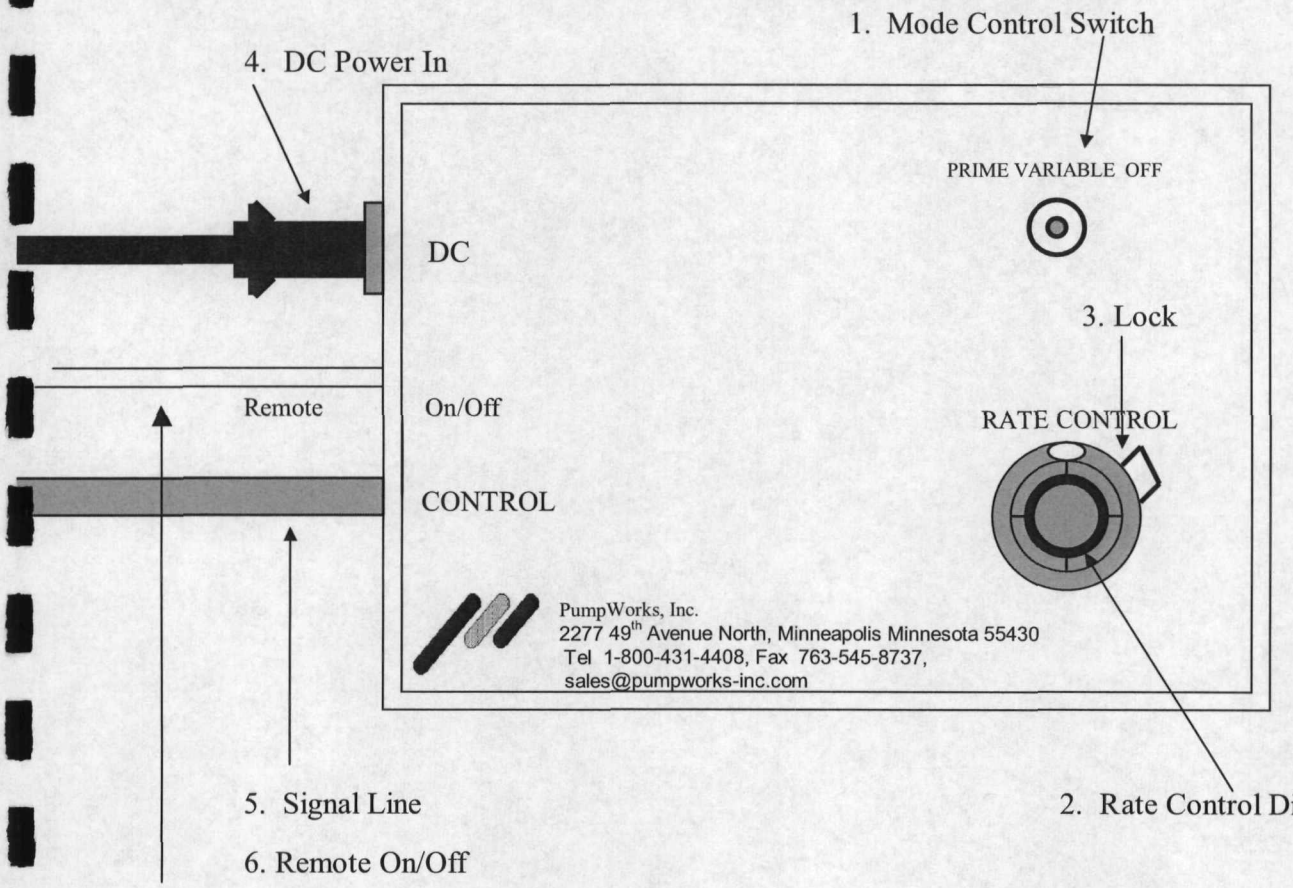
FURTHER OPTIONS - Consult factory for details on implementation
Pumps may be used in series to boost pressure and lift in wells larger than 4".
Pump may be controlled using a timer to allow several minutes or days between operations.
If several pumps are to be used in close proximity a PC or PLC rate control is an option to reduce cost.

PUMPWORKS, INC.

2277 49th Avenue North
Minneapolis MN USA 55441

Phone: 1-800-431-4408 Fax: 612-521-9331 E-mail: sales@pumpworks-inc.com

PW-2000 Series Variable Rate Controller

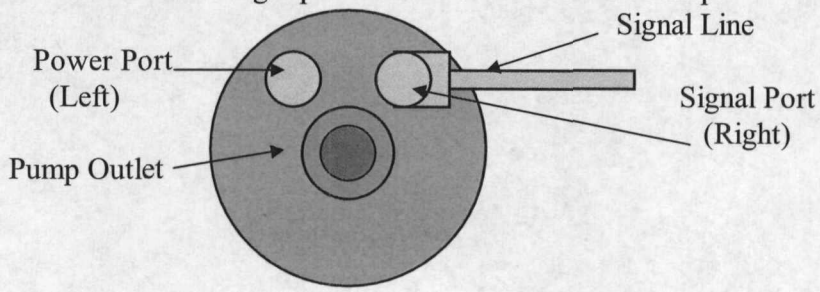


1. Mode Control Switch: Switches mode of operation.
2. Rate Control Dial: Controls the rate of piston cycles of the PW-2000 Series Pump.
3. Lock: Locks Rate Control Dial in desired setting.
4. DC Power In: Power line in from DC power supply.
5. Signal Line: Control Line out to the PW-2000 Series Pump from Rate Controller
6. Remote On/Off: Remote operation of VRC may be performed by any contact closure.

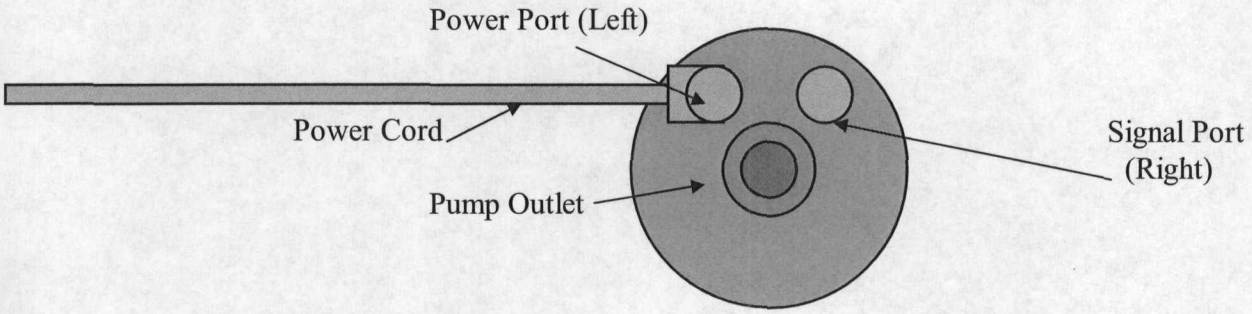
INSTALLATION:

** NOTE: When installing the PW-2000 Variable Rate Controller, make sure the Mode Control Switch is in the OFF position.

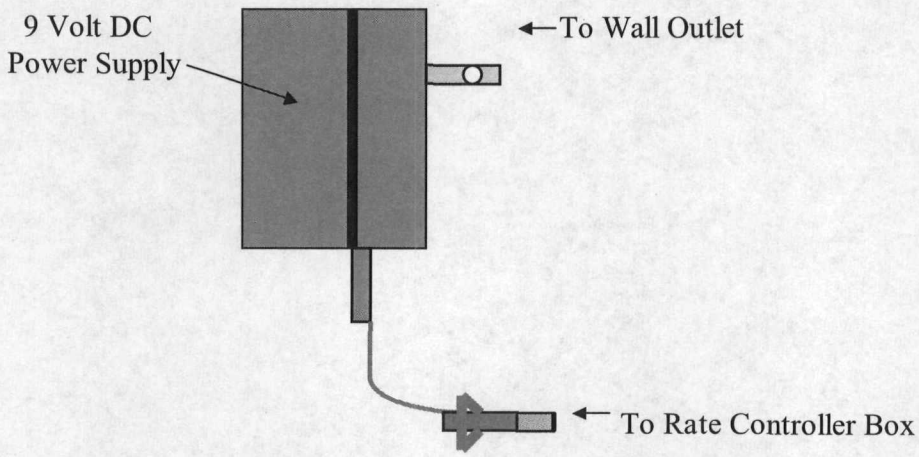
1. To connect the Rate Controller signal line to the PW-2000 Series Pump, screw the male threaded connector onto the right port of the PW-2000 Series Pump.



2. To connect the power cord to the PW-2000 Series Pump, screw the female threaded connector to the left port of the PW-2000 Series Pump.

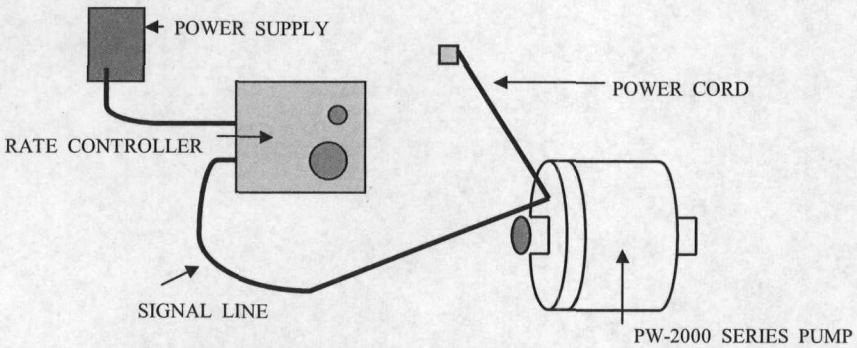


3. Next, plug the 9 Volt DC power supply into a wall outlet (120 Volt AC) and into the Variable Rate Controller box.



4. Plug the power cord from the PW-2000 Series Pump into a wall outlet (120 Volt AC).

5. Optional On/Off: Connect Black wires to relay or dry contact switch.



Your system should now be connected as the above diagram.

For connections to PW2000 Series Hazardous Location Explosion Proof Pump, these wires correspond with each other:

Pump Signal Wires (For control interfacing)	To Variable Rate Controller
• Red----------Forward Stroke Detection	Red
• Blue----------Logic Ground	Green
• Yellow----------Pump Initialize	Black/Red
• Orange----------Pump Disable	White/Red

Special Order:

- Brown----------DS-1820 Pin #'s 1 + 3
- Gray----------DS-1820 Pin # 2

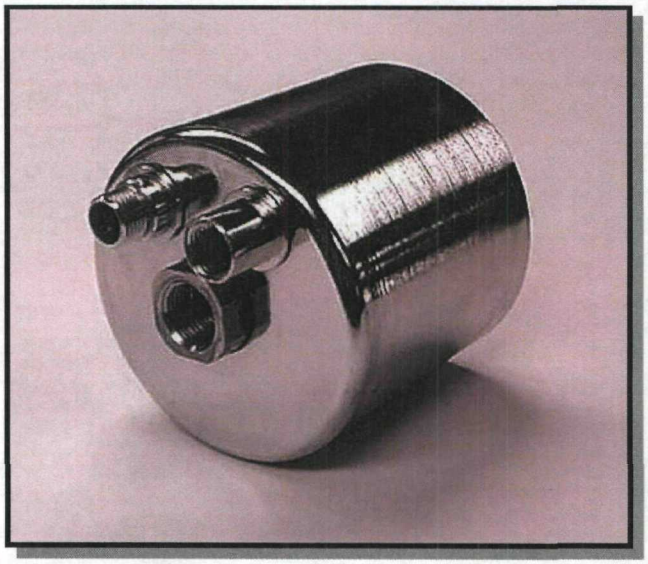
PUMPWORKS, INC.

LIQUID & GAS TRANSFER TECHNOLOGY

PW2000 Series

Model ***PW2002***

High flow, UL-listed, rate-controllable liquid pump



FEATURES

The PW2002 is rate-controllable for infinite flow adjustablity

Control options:

- Simple on/off switch
- Dry contacts
- VRC 2000 Controller
- 4-20 mA systems
- PC or PLC interface
- Custom controls available

PW2000 Series Features

- Magnetically driven
- Leak-proof
- Pump & motor in one package
- Integral solid state circuit board for easy controllability and pump protection
- Compact for flexible installation
- Quiet (<60 db)
- Sealless and oilless
- Self priming
- Dead-head and run dry capable
- Integral overload protection

Custom pumps with expanded capabilities are available

SPECIFICATIONS

Performance

(all figures are maximums, tested on water @ room temperature)

Volume	46 gph
Pressure	45 psig
Inlet Suction	14 in. Hg
Inlet and System Pressure	1400 psi
Particle Size	1/32"
Viscosity	20,000+ cps
Fluid Temperature	140 °F
Power Requirements (watts)	80 - 130

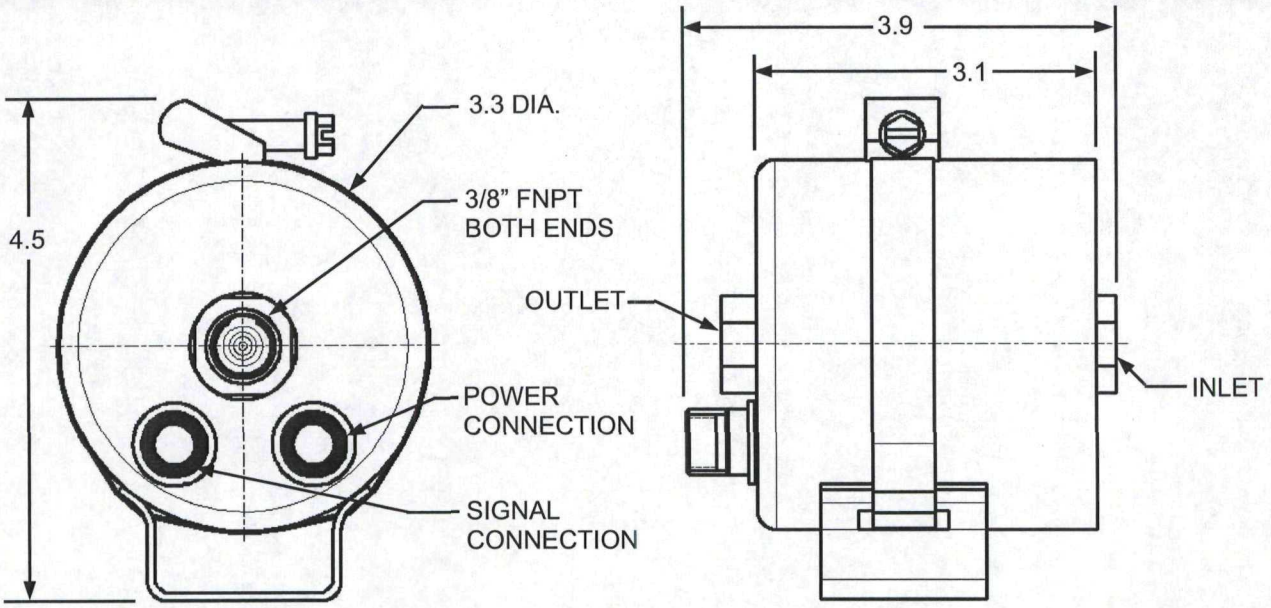
Other Specifications

Weight	4.8 lbs
Inlet and Discharge Port	3/8" FNPT
Voltage (60Hz, 1 Phase)	120V

Materials

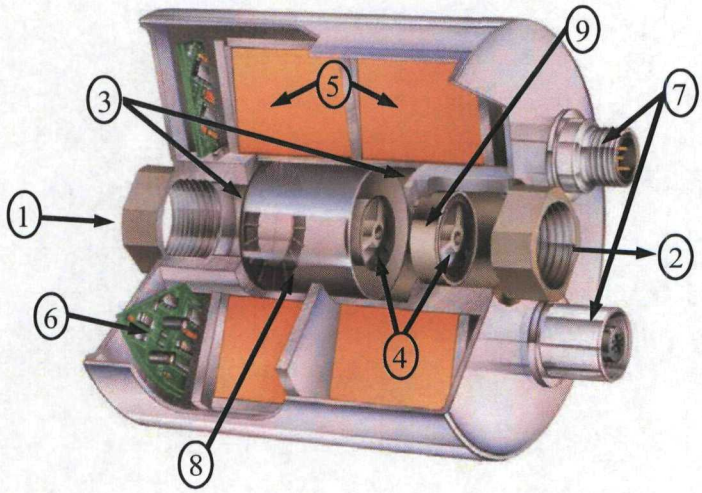
Piston Cylinder	316 Stainless Steel
Housing	316 Stainless Steel
Elastomer Option	Fluorel (Viton equiv.) Neoprene EPDM
Piston	Coated 416 SS
Connections	Electroless Nickel Plated 416 SS

PW2002 DIMENSIONS



Note: All dimensions are in inches, pump shown with optional mounting kit installed

PW2000 SERIES CUTAWAY



1. **Inlet**
2. **Outlet**
3. **Bumpers**
4. **Check Valves**
5. **Coils**
6. **Circuit Board**
7. **Cordset Connectors**
8. **Piston**
9. **Insert**

Note: Cutaway is typical of PW2000 Series. Exact configurations vary slightly within series.

REPLACEMENT PARTS

Item #	Part #	Description	Qty
3	100024-100	Bumper (Fluorel)	2
3	100024-200	Bumper (Neoprene)	2
3	100024-300	Bumper (EPDM)	2
4	100025-100	Check Valve (Fluorel)	2
4	100025-200	Check Valve (Neoprene)	2
4	100025-300	Check Valve (EPDM)	2
9	100026-200	Insert, 2 spoke	1
-	100029-100	Insert Retaining Ring	1
-	100030-100	Insert O-ring (Fluorel)	1
-	100030-200	Insert O-ring (Neoprene)	1
-	100030-300	Insert O-ring (EPDM)	1
-	20057	Elastomer Kit (Fluorel)	1
-	20058	Elastomer Kit (Neoprene)	1
-	20059	Elastomer Kit (EPDM)	1

PW2002-09/00

PUMPWORKS. INC.
LIQUID & GAS TRANSFER TECHNOLOGY

1125 Nathan Lane North
Minneapolis, MN 55441 USA

sales@pumpworks-inc.com
www.pumpworks-inc.com

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